LEAN ON ME – CHOOSING RAILINGS CAREFULLY

3 LU/HSW Credits

AIAPDH232

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PDH Academy

Final Exam

1. _____ to obtain _____ must be met before the design of any railing system is complete.
   a. A completed budget, funding
   b. Code compliance, regulatory approval
   c. Committee review, tenant sign-off
   d. None of the above

2. The Americans with Disabilities Act is a _____
   a. Civil law containing stringent regulations
   b. Contains recommendations to accommodate handicapped users
   c. Is not actually a building code per se
   d. All of the above

3. As an example of the need to verify codes being enforced in a jurisdiction, the current New York City Building Code is the ____ version of the IBC.
   a. 2012
   b. 2018
   c. 2014
   d. None of the above

4. Some jurisdictions contain loading requirements that railings must resist when applied _____ .
   a. Upward, downward, and horizontally
   b. Upward and downward
   c. Horizontally at post connections
   d. During pull-out tests.

5. An allowable stress increase of 1/3 for railing components was eliminated from some codes due to the increasing _____.
   a. Importing of inferior metals
   b. Amount of successful litigation
   c. Lack of trained welders
   d. Use of load factor design

6. Documents guiding the physical creation and installation of products are called _____ .
   a. Prototypes
   b. Mock-ups
   c. Assembly guides
   d. Shop drawings

7. Stamped calculations accompanying railings assure the building designer that the railings comply with _____ .
   a. The designer's drawings
   b. The client's design parameters
   c. Applicable codes
   d. Pull-out test results

8. The term "functional art" refers to custom infill panels typically cut with a _____
   a. Laser
   b. Water-jet
   c. Stamp press
   d. Scroll saw

9. Engineering calculations establishing compliance by a railing manufacturer are best when provided by _____ .
   a. An in-house engineer
   b. The project architects
   c. Outside engineering firms
   d. The shop supervisor

10. Continual handling and the oils on people's hands results in well-handled stainless steel _____ .
    a. Becoming self-polishing
    b. Acquiring a fine patina
    c. Becoming extremely slippery
    d. Etched at the welds

11. The primary reason stainless steel railings are not used more often is _____ .
    a. Weld failure
    b. They become slippery when wet
    c. Limited finish options
    d. Expense

12. One major advantage to the use of composite railings is their _____ .
    a. Warm feel when touched
    b. Many styles and options
    c. Many awards they have won
    d. Brand recognition with realtors

13. LED lights can be integrated into capped composite railing systems _____ .
    a. In tube configuration
    b. At post bases, tops, and in nearby yards
    c. On posts, under post caps, and under railings
    d. Only on custom components

14. Once installed, aluminum railings be expected to last _____ years.
    a. 25-28
    b. 70-90
    c. 25-30
    d. 40-50

15. A much wider variety of stock sizes and shapes are available in _____ than in _____.
    a. Wood, aluminum
    b. Aluminum, steel
    c. Bronze, steel
    d. Glass, cable

16. Railing systems are available that mix components from more than one base material. One examples would be _____ .
    a. Wood rails and porcelain infill
    b. Aluminum rails and stainless-steel stiles
    c. Composite rails and aluminum stiles
    d. Bronze rails and wood X-panel infills

17. When the term “glass railings” is used, this is referring to _____ of glass.
    a. Infill panels
    b. Spider stanchions
    c. Top and bottom rails
    d. All components

18. Laminated glass is multiple sheets of glass adhered to _____ between them.
    a. Argon
    b. A transverse glass pane
    c. Translucent glass
    d. Plastic

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INTRODUCTION

With site development driving up preconstruction expenses, high-rise construction is increasing. Much of this growth is occurring in multi-family residential structures being built to alleviate a shortage of housing in developed urban areas. Most of these incorporate at least a small outdoor living area or balcony. The necessary railings for these form a big part of the visual impact of such projects. Their initial and continued appearance will matter to developers. But railings must first and foremost, meet code requirements like those in the commercial IBC or residential IRC.

Because of differing projects, different project types, different regional influences and different suppliers, architects usually create customized designs and specifications for railings on each job. It would be nice if there were a single universal system or approach to railing procurement. A system allowing a single set of specifications and details to be created and then reused.

What would take for such to be made available? There would need to be enough standardized aesthetic railing systems, materials and styles to satisfy both commercial and residential markets. The products themselves would need to be simple to install and yield consistent results. Even better would be reliable one stop shops, with whom a designer could partner on projects needing railing systems.

If such resources were available, they would be a huge asset to architectural firms.

COURSE OBJECTIVES

This course will cover key factors to consider in the design of railings. These will include; building code requirements, fall prevention concerns, choices in materials, secure installation options, and aesthetic options. These should all be considered when choosing or specifying a guardrail system for a restoration or new construction project.

In a bit more detail, in our time together, we will focus on the following learning objectives. Our goals are to:

- Explore code compliance and how product standardization helps meet that goal
- Increase familiarity with ADA guidelines and other regulations that must be satisfied in the design of railings
- Discuss proper mounting of different railing systems, being installed on different types of construction
- Become acquainted with different material, design and finish options for railings and dividers
- Provide available resources to streamline design decisions regarding railings and privacy dividers.
- Learn about styles and trends in aluminum and composite railing systems and discuss how railing material choices affect appearance, lifespan and maintenance

- Address how standardized railing systems, with attendant standard details and master specifications, simplify each step of a railing project
- Present issues faced in railing replacements in historic projects, as well as ways to accommodate needed historic detailing.
- Demonstrate advantages of establishing a working relationship with a quality fabricator, especially in renovation projects

CODE COMPLIANCE

As with most aspects of the creation of buildings, aesthetic design of railings gets you the approval of the customer, but code compliance to obtain regulatory approvals must be met before the work is complete.

When it comes to railings, what is involved in complying with ADA guidelines and building codes? Note that ADA requirements are mere suggestions, till they are referenced into adopted local or state building codes and standards. Then they become law. Most ADA guidelines are mirrored in local codes.

What is typically required by building codes? To begin with, there are definite differences between guardrail and handrail requirements, found in loading mandates and dimensional requirements. We will touch on these later.

Besides building codes, there are other regulatory agencies with guidelines to which railing design must adhere. These will be discussed briefly.

Railing systems themselves can be certified through the CCRR process, but this certification still does not cover required project specific fasteners. If the project is straightforward, engineering for fasteners can be usually also be provided by the supplier. If the project requires closer attention to fastening details, a local engineer can be hired to verify that proper fasteners are utilized.

No one wants to be involved with a railing system that fails.

Complying with ADA / Building Codes

The best designs for railings in historic buildings will be those that meet current code requirements, while also acknowledging or duplicating existing remaining detailing. Satisfying both needs represents a win-win for the project. But satisfying code requirements begins with an understanding of where the legal restrictions on what we design originate.

The ADA (Americans with Disabilities Act) is not actually a building code. It is a civil law that often contains the most stringent design recommendations to accommodate handicapped users. Building inspectors are not supposed to enforce ADA compliance, but sections of the ADA have often been excerpted and incorporated as local laws. Some examples of ADA suggestions often incorporated into building codes are as follows.

- If a walking surface has a slope of 1:20 or more, an installed handrail is required. The railing should run the entire length of the ramp.
- These requirements do not apply to handrails in elevators or lifts.
- When a ramp's rise is greater than 6 inches, a handrail is required on both outer edges.
- The handrail also must extend for at least 12 inches past the bottom and the top of all ramps.
- Handrails on stairs must be continuous, lining both sides of every stair, as well as around the platforms in between.
- At the top of stairs and ramps, rails should extend for at least 12 inches above the surface of the landing and at the bottom, they should extend a minimum of 12", or the length of one tread.
- In general, all handrails must be positioned between 34 and 38 inches above the walking surface, ramp or stair.
- If the principal users will be children, an additional handrail can be added, positioned no more than 28 inches from the ground.

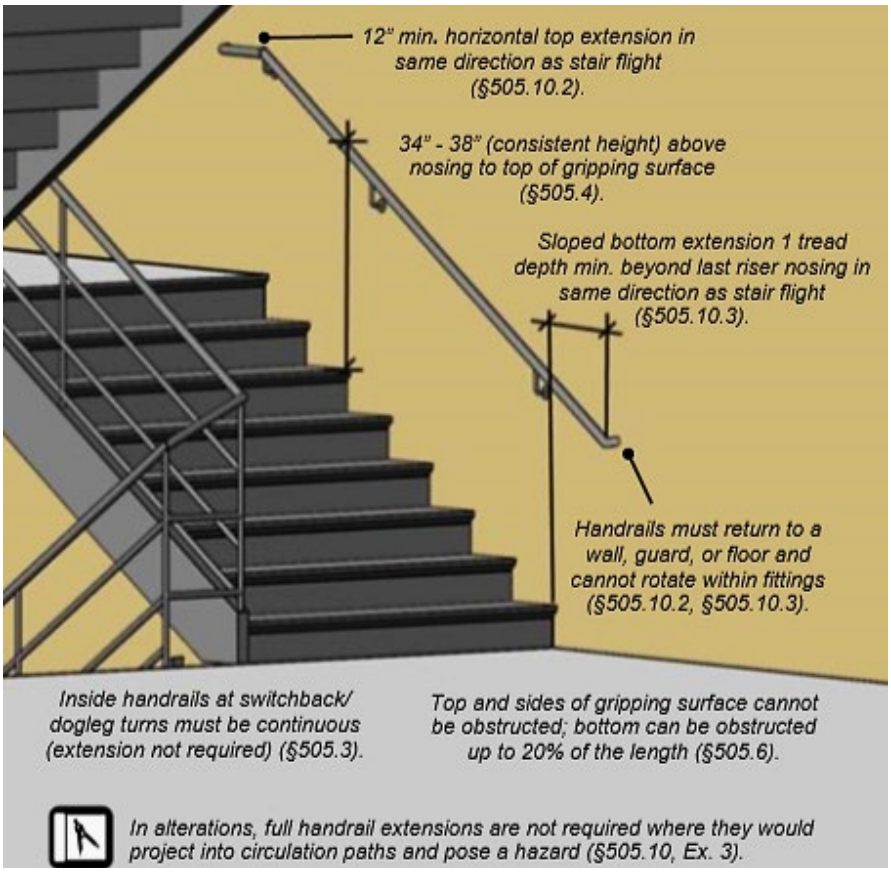


Image excerpted from the US Access Board Technical Guide Stairways

National and Local Building Code Requirements

A brief listing follows as an example of different versions of various codes that must be satisfied in New York, New Jersey and Connecticut. This list is specific to work in New York City, which like many other large urban centers, has created their own additional building regulations.

Requirements from model codes tend to be adopted everywhere. But before proceeding with a design, it is important to determine whether additional requirements have been imposed by more stringent local codes.

- New York State adopted the 2015 IBC (International Building Code), with their own 2017 supplement, which they published.
- The current New York City Building Code is the 2014 New York City Building Code. They are expected to come out with an update soon which will mirror the latest IBC code, but there was no concrete information available on when that might take place.
- New Jersey adopted its own 2015 version of the New Jersey Building Code.
- Connecticut adopted the 2012 IBC with their own supplement, published in 2016.
- The latest version of the International Building Code is the 2018 IBC. This will eventually be, but has not yet been, adopted by most of the previously mentioned jurisdictions.
- Information pertinent to railing design is usually found in, but is not necessarily limited to chapters 10, 11, 15, 16, 17 and 24 of state and city building codes that are based on the model provided by the International Building Code.
- Local Law 11 was an earlier mandate passed in New York City, dealing with façade inspections. It was well understood but has now been mostly superseded by regulations entitled FISP and SWARMP, in which fewer people are versed.
- FISP – The recently passed Façade Inspection Safety Program is a New York City building mandate which must be followed, although it is not necessarily a building code. It was created to ensure continued safe conditions in existing buildings, where building components can fall to the ground, or failure of any building component can compromise the life and safety of the inhabitants.
- SWARMP – The recently passed Safe with a Repair Maintenance Program is also a New York City building mandate, put in place for the same reasons as the FISP program.
- NYC DOB Local Law 196 is a new and fluid program that will take effect in phases. It will affect railing installers, along with other workers. By December 1, 2018, all workers on job sites in NYC, regardless of their trade, will need to be OSHA certified for 40 hours in safety. This can include a 10-hour OSHA card, plus an additional 30 hours. NYC is doubling down on safety and making it a priority. Ultimately, except for special inspectors, no one will be allowed on a job site without this safety certification.
- In a recent development, a section of the NYC Zoning Resolution Article 2, Chapter 3 (23-131) has been interpreted to mean privacy dividers cannot exceed 3’-8” in height. The actual text states, “In addition, balconies may be enclosed by “building” walls provided that at least 33 percent of the perimeter of such balcony is unenclosed except for a parapet not exceeding 3 feet, 8 inches in height, or a railing not less than 50 percent open and not exceeding 4 feet, 6 inches in height. The portion of a balcony enclosed by building walls shall not exceed six feet in depth.” It remains to be seen if this clause will continue to be interpreted as also referring to privacy dividers, since a privacy divider limited to 44” in height provides very little privacy.
- The Aluminum Design Manual contains critical information, often referenced and incorporated into codes. The most current version of this manual is the 2015 edition, but the 2014 NYC Building Code references the 2005 version of the Aluminum Association’s Design Manual. This manual is very important when designing railing

systems of aluminum alloys. It defines what each specific shape and size of an extrusion of aluminum is capable of withstanding, strength-wise.

A Moving Target

Since codes are constantly being changed and updated, it is important to stay abreast of current requirements. But there are certain mandates to be met in railing design that are consistent across jurisdictions. Some of these are as follows, with additional commentary about more stringent requirements found in the NYC codes.

- When it comes to allowable railing materials, any material that is non-combustible can pretty much be used if it can meet strength requirements.
- There are certain specified horizontal loads which railings must be designed to withstand.
- Load requirements to be met by guardrails are defined in Chapter 1607.7, and live loads are specified for handrails and guardrails, even for ramps and stairs. All must resist a 200# concentrated point load, applied at the top in any direction. Though not simultaneously, they must also be designed to resist a uniform load of 50# per linear foot of railing length, applied at the top of the railing in any direction. In addition to those mandates, an infill panel of any composition must resist a live load of 50# / SF, located at the place in the railing infill that will result in the worst-case stress in the railing. These loading requirements originate in the IBC and are consistent across state and local jurisdiction codes.
- Note that NYC has an additional loading requirement on the infill area of railings, of a concentrated upward load of 50# located in the worst possible scenario. This usually creates the worst problems in the intermediate or bottom rails, but the requirement applies to all railing components. This requirement was put in place following a loss of life that occurred when improperly installed railing connections were not strong enough to meet all loading requirements, though the railings themselves did.
- NYC also has an additional loading requirement of a 50# / ft uniform load applied downward on all components, including any intermediate rails or bottom channels.
- When it comes to determining allowable increases for stress design, there was a big change that occurred between the 2008 and 2014 NYC building codes, located in section 1607.7. A subsection was eliminated that once allowed an allowable stress increase of 1/3 for components and anchorages of guard railings, when they were being subjected to live loads. When calculating mandated loads before that, engineers could increase the strength of such railing materials by an additional 1/3 above allowable strengths found in design manuals for those materials. As the engineering community gravitated toward LRFD design (load factor design), that allowable increase was removed from the code as being inconsistent with LRFD design. As a result, railings designed prior to the 2015 adoption of the new code might work just fine on paper. But in renovation projects, it would be very difficult to match the design of those older railings with new ones, given the now more restrictive interpretation of the code.
- Railings in zones like building corners, that are subjected to winds passing by and around them, must meet more stringent requirements than other railings on the same building which are not in such zones.

- Guardrails on commercial projects, installed to protect against a fall from any height over 30", are required to be a minimum of 42" high. These are generally designed to be ½" to 1" above that minimum height requirement to allow for tolerances or variances in installation or in mounting surfaces.
- Handrails above sloped runs of stairs and ramps can be between 34-36" above the slope of the stairs, but they must still be raised to 42" above any landings where they will function instead as guardrails.
- Some jurisdictions require handrails to be as much as 38" above the walking surface or the nosing line of the stairs.
- Maximum allowable openings in railings is pretty consistently 4". What is mandated is that railings must be designed so a 4" sphere cannot pass through any portion of the railing, or between the railing and the structure. Railings are usually designed instead to prevent passage of a 3 7/8" sphere, so there will be no problem if minor variations occur in installation or through deflection.
- In the portion of a railing occurring above 36", an exception in some codes allows for a 4 3/8" sphere to pass through openings in that upper portion of the guardrail. The change in design for the last 6-8" in height is most likely not worth the additional effort in fabrication and any potential future problems.
- In areas not open to the general public, or around elevated surfaces used to access mechanical equipment, railings must be spaced to prevent the passage of a 21" sphere.
- In a rail on the side of the stair, where a triangle is formed by the railing, tread and riser, a slighter larger opening is usually permitted, with up to a 6" sphere allowed to pass through.
- Enforced by many jurisdictions, the ADA does require a handrail on both sides of stairs and ramps, with a minimum of 36" clear between the handrails. At any place where someone in a wheelchair would need to turn around, the 5' diameter clear space needed for that would also apply to the space between railings.

Additional Sources of Restrictions

Besides building codes and recommendations found in publications like the ADA, there are other sources of requirements for railing design to which adherence must be maintained. Some of these are listed below as well:

- The designation of ASCE-7, refers to publication #7 of the American Society of Civil Engineers. This publication deals with imposed loads on building structures. It also designates structural requirements for railings and these requirements are often referenced by newer building codes. Rather than spelling out all the loadings on guardrails, some building codes just reference the appropriate portions of ASCE-7.
- OSHA – Created by the U.S. Department of Labor in Federal Regulation #29 CFR, OSHA (the Occupational Safety Health Administration) is an agency only concerned with employee safety. It publishes mandated guidelines that must be followed to protect employees. It is possible to build a railing that is OSHA compliant, but not code compliant, or vice versa. If a railing is accessible to the public, mandates of the building code must be met. If it is accessible to both the public and employees, then requirements

from both OSHA and the building code must be satisfied. Usually building codes are more stringent than OSHA, in terms of openings, heights, etc.

- The National Fire Protection Code has a couple of special requirements that can become an issue. These requirements include the amount of clearance required between a wall and the inside face of handrails found on stairs and ramps. The intent is to ensure enough space between the rail and wall to accommodate a fireman's glove.

Whenever multiple rules, mandates, and codes apply to a project, the most stringent requirements found in them must be met. The final authority as to whether all requirements have been met, will be building departments and building inspectors, responsible for the safety of building users. Even renovation projects must be inspected and passed by code inspectors upon completion.

Review Questions 1:

1. Handrails and guardrails are usually the same height, with _____ required between stiles.
   a. Slightly different spacing
   b. The same spacing
   c. Mesh up to 18"
   d. Openings large enough to pass a 20" sphere

2. Handrails must generally be positioned _____ above the walking surface of a ramp or stair
   a. 34"-38"
   b. 29.5"
   c. 42"
   d. 36"-42"

3. _____ contains critical information, often referenced and incorporated into codes for the design of railings
   a. The Aluminum Design Manual
   b. The AISC manual
   c. U.S Guide to Stairway Design
   d. OSHA's Regulatory Handbook

4. Most allowable openings in railings are consistently sized to prevent the passage of _____ .
   a. A 4" sphere
   b. A child's shoulders
   c. Windblown debris
   d. A woman's high heel

5. OSHA is an agency only concerned with employee safety.
   a. The lives of underage children
   b. Outside safety for handrails
   c. Employee safety
   d. Aggressively growing in jurisdiction

DEFENDING DESIGN CHOICES

In Search Of …

Design decisions are sometimes carefully thought out, based on a consideration of available options leading to an apparent best choice. Sometimes they are just the first solutions we find that appeal to us. But when the client asks us why we chose an option, it's always best if we can honestly say we considered several first. So we go searching for data on which to base decisions.

In Search of Solid Rationale

What we seek from suppliers of railing systems is information usable when presenting choices to a client. What exactly makes the selection of one style or another of a railing or divider a better decision? Why one material versus another? What are the maintenance considerations involved? If it is a renovation project, we need to know how what has been selected will attach to the existing construction. If new construction, will the selected railings work with the designed structure and style?

In Search of Aesthetic Choices

There are many aesthetic choices involved in railing selection. How much visibility is desired through chosen railings or dividers, given the view that will be seen? Once a style and system has been selected, the proper material coatings for the job must be picked. What available color or finish in that coating will best compliment the rest of the project?

In Search of Assistance

In a perfect world, designers would be experts in every building material utilized in a project. In the real world, it's really nice to find an expert resource in the design department of a product manufacturer. One who can be consulted about choices that fit the building and the need. Opinions that are backed by extensive experience.

In Search of Resources

When they make themselves available for consultation, designers will turn to manufacturers with experience to help specify product and understand codes, standards, engineering, etc. Especially valuable to busy offices are DWG files made available for offered products, rather than PDF files of details, obviously already drawn in CAD. There isn't much interest in having to draw them again. As a side note, not many architects are also interested in signing up for unwanted emails, just to get access to, or even see, resources offered by a railing manufacturer.

In Search of Verifiable Compliance

Reassurance that chosen railings with comply will applicable codes is very important to most architects. This generally involves some sort of certification or paper trail establishing that the products have been tested for the same and have passed those tests. This documentation should

include ways and means in which the product was tested, preferably by a testing agency not connected to the manufacturer.

In Search of Engineering Proving Compliance

To meet code requirements, many companies hire outside engineering firms to provide design calculations and shop drawings guiding the physical creation and installation of the product. These documents can typically include calculations and drawings regarding:

- Design Loads, Handrails & Splices
- Typical Posts & Mandrels
- Corner Posts & Mandrels
- Mounting Connections & Bottom Channels
- Pickets
- Dividers

Certifications for Railings and Dividers

Design Criteria that is verified as being met can include code-related requirements, such as:

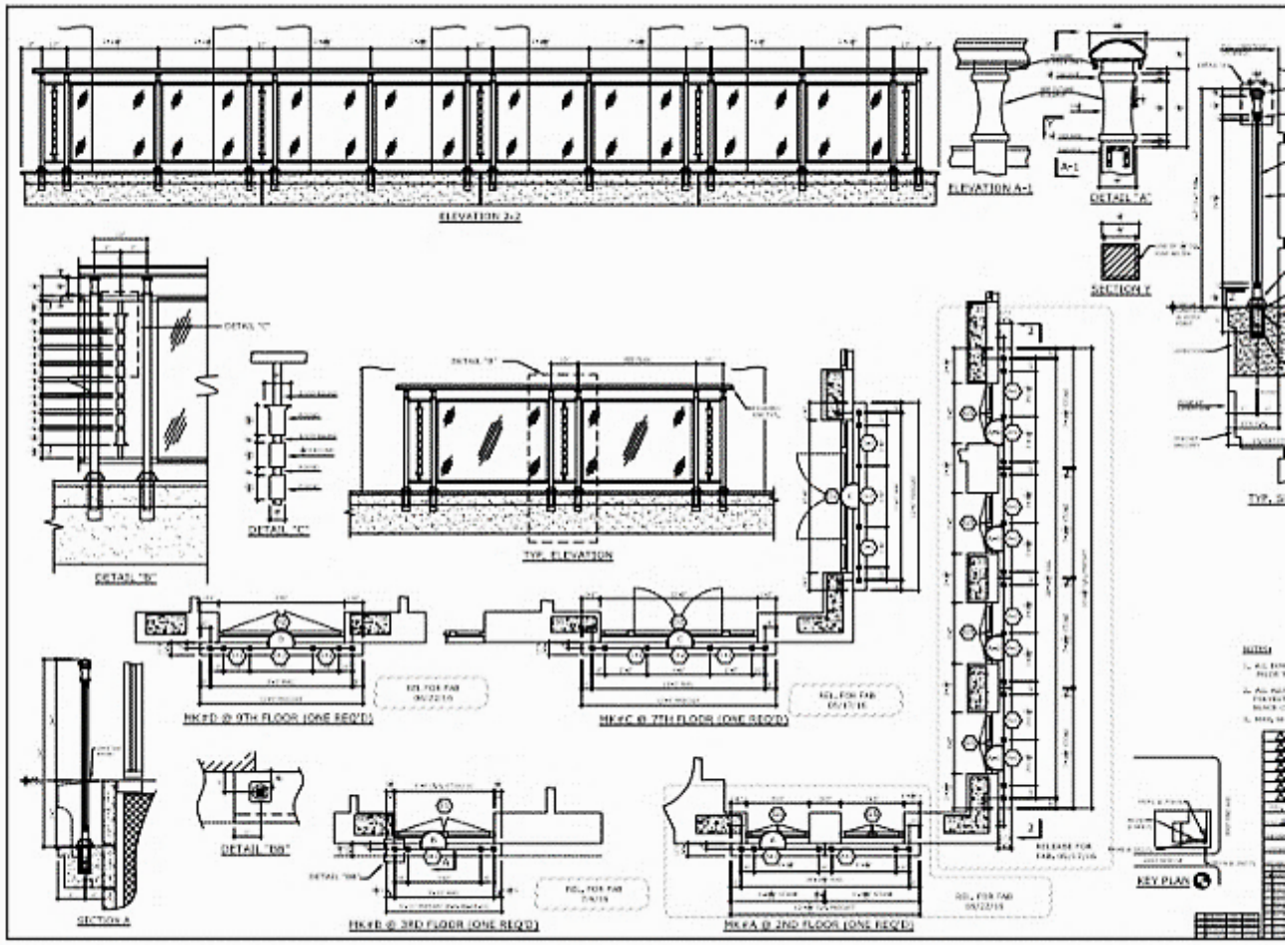
- Railing & Divider live loads per 2014 NYC Building Code
- Railings & Dividers designed using Allowable Stress Design (ASD) method unless noted otherwise
- Railing & Divider deflections per ASTM E985 or IBC (Most Stringent)
- Railing & Divider design wind loads per IBC (ASCE-7-05)
- Aluminum members designed per the Aluminum Design Manual
- Steel & Stainless-Steel Members designed per the AISC, “Manual of Steel Construction: Allowable Stress Design”, 14th Edition.
- Member sizes, grade, alloy and strengths shall be as recommended in the calculation package
- Stainless steel fasteners to be minimum Condition “CW”, 300 Series, Fy= 65 ksi
- All other fasteners shall be the size and strength as is recommended in the calculation package
- Aluminum welds to be 5356 filler alloy unless otherwise noted
- Steel welds to be E70XX filler alloy unless otherwise noted
- Concrete strength is assumed to be F’c= 4,000 psi, normal weight
- Concrete anchors shall be as recommended in the calculation package. Installer is responsible for maintaining the fastener spacing, edge distance, end distance, embedment depth and minimum substrate thickness that is recommended in the calculation package
- Concrete anchors shall be installed per manufacturer’s recommended installation procedures, including recommended ambient temperatures for chemical/adhesive anchors
- Concrete slabs, curbs, structural steel, masonry units and all other anchorage substrates designed by others
- Shim dis-similar metals. Maximum recommended shim height for guardrails is 1/2", full bearing shims

There will also usually be a disclaimer covering what certification does not include, such as: This certification is limited to the structural design of structural components of this handrail & divider system. It does NOT include responsibility for:

- Structural design of misc. hardware (latches, hinges, etc.)
- Structural design of concrete slabs, parapet walls or other masonry units
- Structural design of wood blocking or wood framing
- Structural design of all other anchorage substrates
- Glass breakage due to airborne debris or foreign objects
- The manufacture, assembly or installation of the system
- Quantities of materials or dimensional accuracy of drawings

Essentially, stamped calculations accompanying railings and dividers assure the building designer and code officials that a professional engineer is certifying that the railings comply with all applicable codes. In some jurisdictions, proving compliance may also require designating personnel to verify as-built conditions prior to fabrication

Shop drawings are often supplied with precise installation instructions. A partial example of such a shop drawing is shown below.



Drawing example provided courtesy of S & S Manufacturing

As-built drawings may also be required detailing what was ultimately installed in the project.

Specifications for Railings

A little knowledge of how a railing is built will help determine how to best specify one for a quality railing project. Watching the actual manufacturing of railing in a nearby fabrication shop is invaluable. If that is not possible, finding a YouTube video showing an overview of that process comes in a close second.

One of the first decisions needing to be made in specifying railings, is deciding which base material will be specified for the system. Basic materials available include; steel, stainless steel, bronze, glass, aluminum, hardwood, LED components, cable or combinations of the above.

Stainless steel

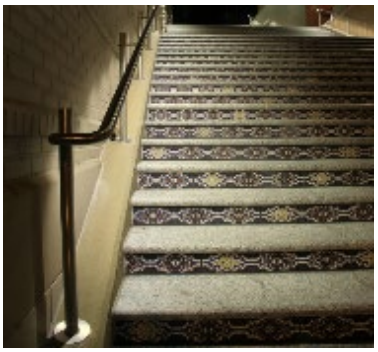
Steel

Bronze

Aluminum

Hardwood

Glass



Wood and Cable Bronze and LED Lighting Aluminum and Metal Mesh
Project photos provided courtesy of Livers Bronze

Sourcing the Product

Some consideration should also be given as to whether railings for a job should come from relatively local sources or whether imported products will serve just as well. There are always questions when products are imported, and no real knowledge exists as to the origin and manufacture of materials offered in the market. Questions about imported products should include; price, quality of the components, how much shipping costs and tariffs have been added to the product price, what the chain of custody occurred between production and their arrival on the job site and what recourses are available? Specifically, who will supply remedies if a problem arises with imported goods?

There may be projects where specifying and pairing together components from different sources may appear to be a good solution. Should that be done, an important advantage is being lost if entire systems are not obtained from one fabricator. Single source manufacturing is also single source liability. Otherwise, every manufacturer involved has multiple other people who can be implicated as the source of any problem with their product.

Advantages to specifying local suppliers include the ability to claim loyalty to area employers, shorter lead times on any additional or replacement parts needed, the incorporation of a fabricator as a readily accessible part of the project team and the ability to apply for restoration grants that require using local suppliers when possible. It is sometimes possible to even visit with local fabricators, see their process and collaborate with them in person, when problems arise that need collaboration prior to resolution.

Sustainability

If certain certifications will be sought, it could become important whether the specified product is environmentally friendly. Can the materials from which the railing components are made be recycled? Do they already include recycled content? Are they shipped to the job site in packing materials that are easily recycled?

Additional Rationale for Choices

Some materials and designs are specified simply because of designer preference. Relatively recent changes in taste moved specifiers toward heavy use of steel or aluminum frames for railings comprised mainly of glass panel inserts. But their use has become fairly cliché at this point in time.

A Familiar Sight
Photo provided courtesy of Livers Bronze

A More Interesting Approach
Photo provided courtesy of Livers Bronze

Now materials like bronze rails with laser cut infill panels offers more variety and more individualistic solutions, so designers can better express themselves. Different frames, combined with different infill panels, become a canvas or a palette of sorts with which to design. "Functional art" refers to custom infill panels, of steel, aluminum, bronze, wood, etc., created for specific jobs to enhance the building design, while at the same time satisfying code requirements.

Example of Custom Infill Panels
Photo provided courtesy of Livers Bronze

Example of Custom Infill Panels
Photo provided courtesy of Livers Bronze

Some railing systems are specified just to secure the services of a local or desired fabricator for the project. Besides railings, desired fabricators may have capabilities for laser-cut metals, signage, art, gates, trellises, water features and sculptures. Such versatility is useful when additional building components in a restoration project might be desired to match the historical theme.

Railings Created by Fabricator
Photo provided courtesy of Livers Bronze

Chandelier Also Created by Fabricator
Photo provided courtesy of Livers Bronze

Different railing systems and designs can be specified in the same project to subtly help distinguish building zones. One system can be used in public spaces, another in more private areas and yet another in service areas. Building users will quickly learn the visual distinction being offered to them by the visible railings.

Testing to Insure Compliance

Compliance of designed railings to meet mandated load resistance is critical information needed by designers and that compliance can be conveyed, determined and established by a variety of methods. These include:

- Calculations are often provided by engineers or labs hired by the manufacturer, so the engineer of record for the building can be sure railings will properly withstand all imposed loads.
- For obvious reasons, engineering calculations establishing compliance by a railing manufacturer should be provided by an outside engineering firm.
- Railing manufacturers should be willing to provide signed and sealed shop drawings for specific projects, showing calculations and compliance with specified loads. These can be loads that are specified by building codes based on ASCE-7, loads from wind tunnel studies conducted for new construction that provide loading towards which to design, and/or in rare cases, applied loads requested to be met in the project specifications.
- Though not a part of codes, on-site load testing of installed products is sometimes also required in project specifications.
- In-shop destructive testing is sometimes done with mock-ups, so a manufacturer can assure themselves that their designed product will perform as engineered. This ensures they can meet design goals. Sometimes a product might even perform better than expected.
- Scientific testing labs are also sometimes engaged to determine the true strength of fabricated railing components and designs. This allows a defendable by-pass of the apparent limitations of the Aluminum Design Manual, to create the look desired by the designer. Third-party lab tests that are conducted must still conform to requirements and step-by-step testing procedures outlined in the Aluminum Design Manual, and any applicable building codes.

- When determining structural capacities, on-site pull-out tests for anchors are becoming more and more common. Anchor manufacturers will literally test installed anchors and apply loads to them, to determine the ultimate loads such installed anchors will resist. Whether at the wall or the floor, the goal is to prove the installed anchors will meet or exceed the desired and mandated loading.

Review Questions 2:

6. Reassurance that chosen railings with comply will applicable codes as designed is usually provided by _____
   a. Sworn affidavits
   b. Corporate product literature
   c. Outside agency testing
   d. Proof of no prior lawsuits

7. _____ is not usually covered by certifications for railing designs.
   a. Welds
   b. Design of substrates for anchors
   c. Member sizes
   d. Live loads

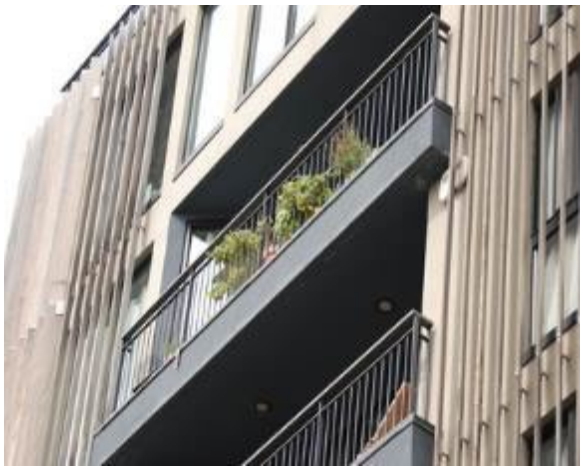
8. One major disadvantage of imported products is no clear delineation of _____ .
   a. Who will pay sales tax
   b. Who will handle pre-assembly of components
   c. Whether U.S patents have been violated
   d. Who will resolve any problems with the product

9. Ways to test railing strength do not include _____
   a. Scientific testing labs
   b. In-shop destructive testing
   c. On-site pull-out tests
   d. Induced accelerated corrosion

RAILING MATERIALS AND STYLES

Choosing Railing Materials

It almost goes without saying, that the design of a building element that will be repeated multiple times in a pattern on a building façade, will greatly affect the aesthetics of that building. The design of railings can be used to augment the building's desired look and appeal. Styles can range from basic picket railings to products of the wildest imagination.



Baluster Railing

Glass Railing

X-Panel Railing

Mesh Panel Railing

Photos provided courtesy of S & S Manufacturing

The starting point of such decisions lies in the choice of which railing material to utilize. It begins with examining the primary differences between ferrous and non-ferrous railings, their strengths and their weaknesses.

Ferrous Railings

There is one huge disadvantage to using carbon steel for railings. It deteriorates, compromising the strength of both the railings and their fasteners. Inevitable rusting requires ongoing maintenance and application of protective coatings to slow down that corrosion. Even then, the process is only slowed and deterioration will continue. When ferrous railings rust, base material is lost, compromising the structural capability of the railing. Unchecked, rust will eat the material

away completely. That same rust may also bleed off the railing and wash down, to stain the side of the building or surrounding areas.

Other disadvantages to ferrous railings include their weight. Steel is very heavy and difficult to transport and handle. Steel railing components are also fairly limited in profiles and shapes in which they can be obtained.

There are still compelling advantages to the use of steel railings. They are stronger than non-ferrous choices. They also cost less, due in part to extensive competition in the marketplace from numerous manufacturers. Steel can also readily and easily be welded in the field, allowing a railing to be modified or cut and fabricated in place, should one be needed in a hurry.

Stainless Steel Railings

There are many advantages to the use of this material for railings. Stainless steel is much more durable than aluminum and is therefore used more in institutional buildings like stadiums, schools, restaurants, subway stations, train stations, bus depots, airports, etc. Its strength makes it suitable for use in areas where people will be holding onto it and using it all day long, in more continuous use applications. Stainless steel is more resistant to dings and dents and will hold up longer under heavy use.

Stainless steel is not only durable, it is corrosion resistant. Continual handling and the oils on people's hands results in well-handled stainless steel becoming self-polishing. It will not however, remain totally stain-free. Stainless steel will oxidize and get stained when in contact with many corrosive materials like salt, chemicals and environmental contaminates. But such corrosion will not compromise the structural integrity of stainless steel. Though its surface may turn orange and look like rust, such corrosion will only occur on the surface. It can be removed with an abrasive pad that is metal free. Then the base material can be re-polished.

Stainless steel does require some annual maintenance to maintain the aesthetics of the railings. This is primarily done by re-polishing it.

One other chemical aspect of stainless steel makes it very usable as an isolator. If necessary, stainless steel can be welded to carbon steel, making hybrid systems possible. Stainless steel can be welded to exposed carbon steel fasteners or angles, then aluminum railings slipped down over or fastened to the stainless steel. Carbon steel cannot be used in direct contact with aluminum, due to the galvanic response between the two. But stainless steel can be used as an isolator between carbon steel and aluminum, or between aluminum and concrete.

The primary reason stainless steel railings are not used more often, is expense. The use of stainless steel involves an expensive product and manufacturing process.

Composite Railings / Capped Polymers

Styles and trends of composite and capped polymer railings differ, depending on location and whether the project is single family or commercial use. Capped composite polymer railings are

offered with options for infill panel materials. Such railings mimic the look of more traditional wood options, but with decades of wear resistance and color fastness guaranteed. Choices of infill panels include; stainless steel stiles. composite stiles, aluminum stiles, glass panels and cable railings. Most railing systems come in several choices of colors. Almost all available styles utilize concealed fasteners. Composite railings are primarily utilized in residential applications, but they are also suitable and certified for use in commercial projects.

Post enclosures are offered in a variety of styles, with a variety of lighting options on and atop them. Under-rail lighting is also available.

The exact same composite railing systems are now carried by distributors in over 1300 locations across the nation. With such wide distribution, code compliant composite railings are now available, made from the same components by the same manufacturer, with extremely short lead times. This makes it possible to develop specifications and details for composite railings just once and then reuse those solutions, specifications and details in many projects nationwide. This master specification can be created with confidence, knowing an identical product will be delivered by a nearby distribution facility, regardless of project location.

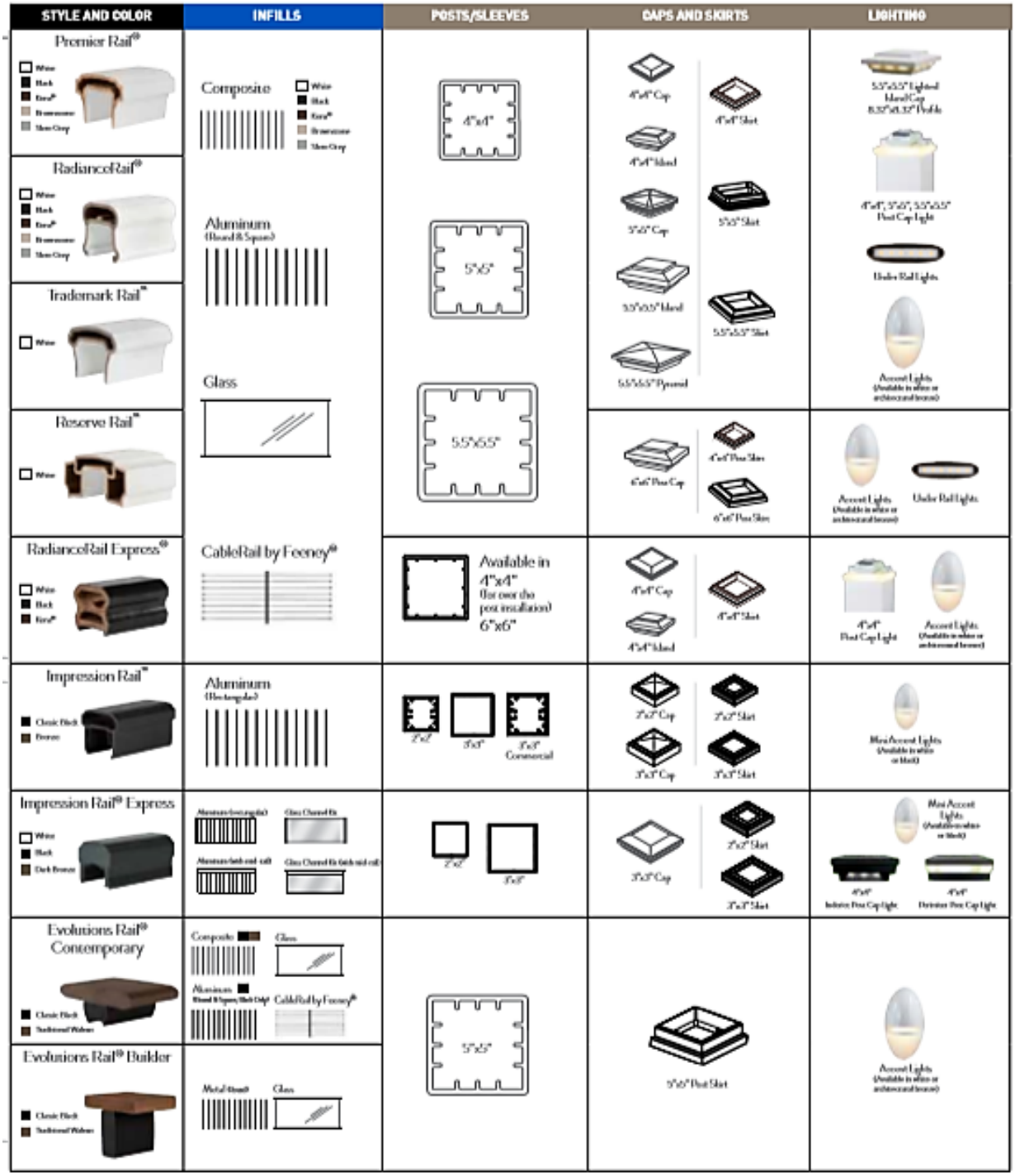
As the charts below illustrate, many styles, trim packages, post styles, lighting options and infill panels are available in composite products.

	CLASSIC RAIL PROFILES				
	PREMIER RAIL®	RADIANCERAIL®	RADIANCERAIL EXPRESS®	TRADEMARK RAIL™	RESERVE RAIL™
25-YEAR LIMITED WARRANTY*	X	X	X	X	X
COMPOSITE BALUSTERS	X	X	X	X	X
ALUMINUM BALUSTERS *SQUARE AND ROUND*	X	X		X	X
ALUMINUM BALUSTERS *RECTANGULAR*					
METAL BALUSTERS					
CABLERAIL BY FEENEY®	X	X		X	X
GLASS CHANNEL KIT *GLASS NOT INCLUDED*	X	X		X	X
HIDDEN FASTENERS	X	X		X	X
MIX-AND-MATCH COLORS	X	X	X		
LOW-MAINTENANCE	★★★	★★★	★★★	★★★	★★★
RESISTS SCRATCHES, STAINS, AND FADING	★★★	★★★	★★★	★★★	★★★
RESISTS MOLD AND MILDEW	★★★	★★★	★★★	★★★	★★★
SPLINTER FREE	★★★	★★★	★★★	★★★	★★★
COLOR OPTIONS	5	5	3	1	1

Chart provided courtesy of [AZEK Building Products]

	CONTEMPORARY RAIL PROFILES		
	EVOLUTIONS RAIL® CONTEMPORARY	EVOLUTIONS RAIL® BUILDER	IMPRESSION RAIL®
25-YEAR LIMITED WARRANTY*	X	X	X
COMPOSITE BALUSTERS	X		
ALUMINUM BALUSTERS *SQUARE AND ROUND*	X		
ALUMINUM BALUSTERS *RECTANGULAR*			X
METAL BALUSTERS		X	
CABLERAIL BY FEENEY®	X		
GLASS CHANNEL KIT *GLASS NOT INCLUDED*	X	X	
HIDDEN FASTENERS			X
MIX-AND-MATCH COLORS	X		
LOW-MAINTENANCE	★★★	★★★	★★★
RESISTS SCRATCHES, STAINS, AND FADING	★★★	★★★	★★★
RESISTS MOLD AND MILDEW	★★★	★★★	★★★
SPLINTER FREE	★★★	★★★	★★★
COLOR OPTIONS	2	2	2

Chart provided courtesy of [AZEK Building Products]



Available Component Styles
Image provided courtesy of AZEK Building Products

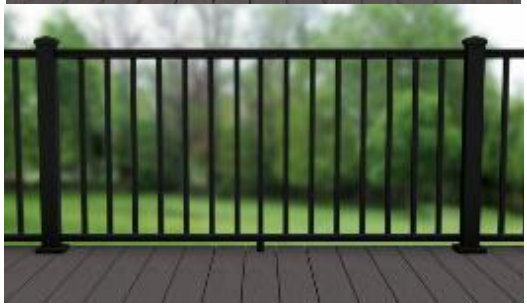
Available Composite / Capped Polymer Railing Styles

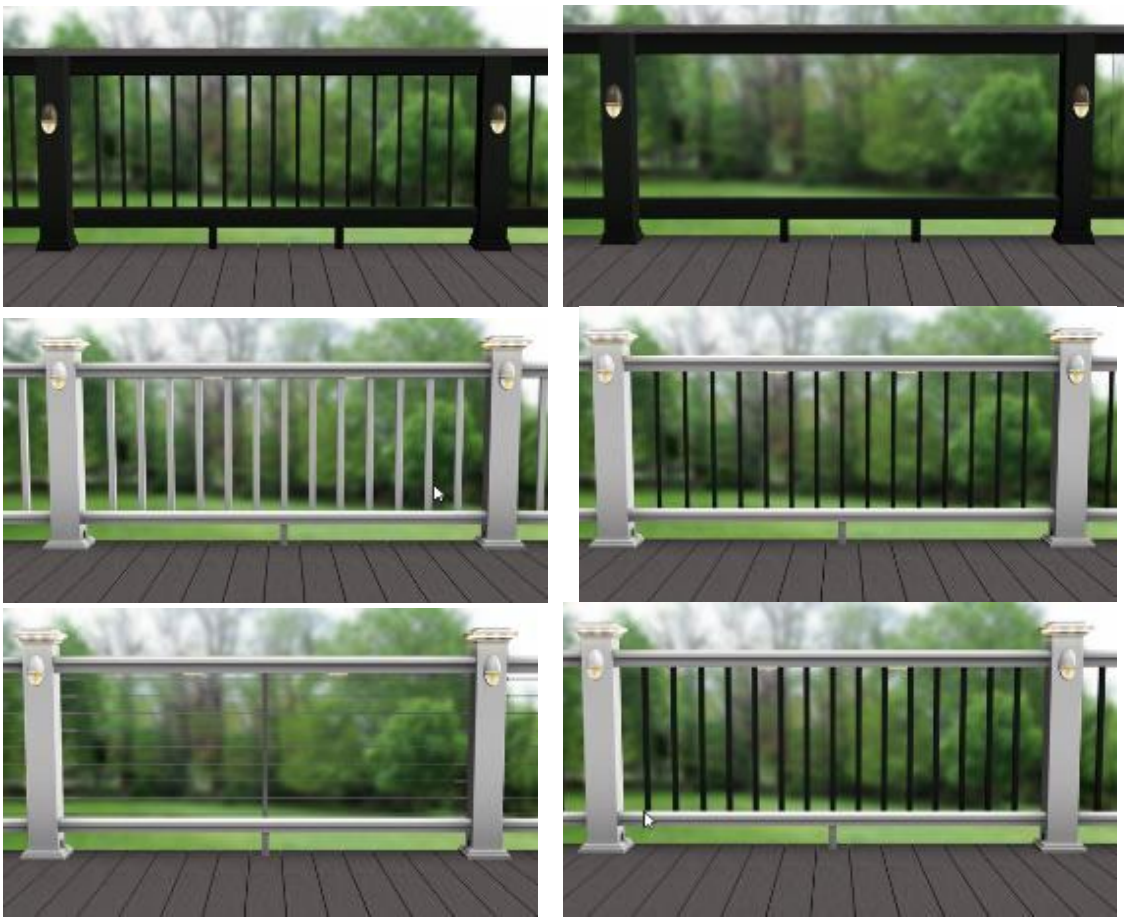
Regardless of the selected style, the use of composite or capped polymer railings offers several project advantages. These include; ease of ordering, speed of fabrication, speed of installation,

beauty, hidden fasteners, versatility for use anywhere and more than enough strength to meet requirements dictated by code.

These railing systems are available in both contemporary and more modern styles. With this material, the look and feel of real wood can be obtained without painting or staining. Unlike traditional lumber, capped composites use PVC performance materials, engineered for superior safety and strength, and will not rot, peel or splinter. With hidden hardware and easy, one-person installation, these can be used to create a beautiful and low-maintenance rail system.

Most manufacturers offer choices in available styles. One offers eight high-end, low-maintenance railing systems. Select the system that's right for your space.





Capped Composite Railing Styles
Photos provided courtesy of AZEK Building Products

Capped Composite Posts and Finishes
Photos provided courtesy of AZEK Building Products

Railing colors for such components come in selections such as black, white, kona, brownstone, slate grey and traditional walnut. Infill panels come in black and stainless. Posts can also be obtained in colors like black, white, kona, brownLED lights are available for composite stone, slate grey and traditional walnut.

Lighting can be integrated into capped composite railing systems as well. LED lights are available as accent lights on posts and under post caps, as well as under railings.

Ordering capped composite railing systems from home building retailers has become a streamlined process. The preferred style and color are chosen. Preferred infill panels like balusters, cable or glass are selected. Then sleeves and finishing touches like caps, skirts and lighting are picked.

Aluminum Railings

Aluminum railings are often specified, especially in residential projects. Aluminum is lightweight and maintenance free. Once installed, aluminum railings can last 40-50 years, making aluminum basically a lifetime product. Styles and trends differ, so multiple options are consequently available for aluminum railings for commercial use. Powder coatings make it possible to offer multiple, durable finishes.

The same railing systems can now be made the same way using the same materials for projects nationwide. Standardizing the manufacturing process using patented machinery makes for lower cost and shortened lead times for product delivery. Customization of railings for specific projects is still possible. It is just done more simply and with greater precision.

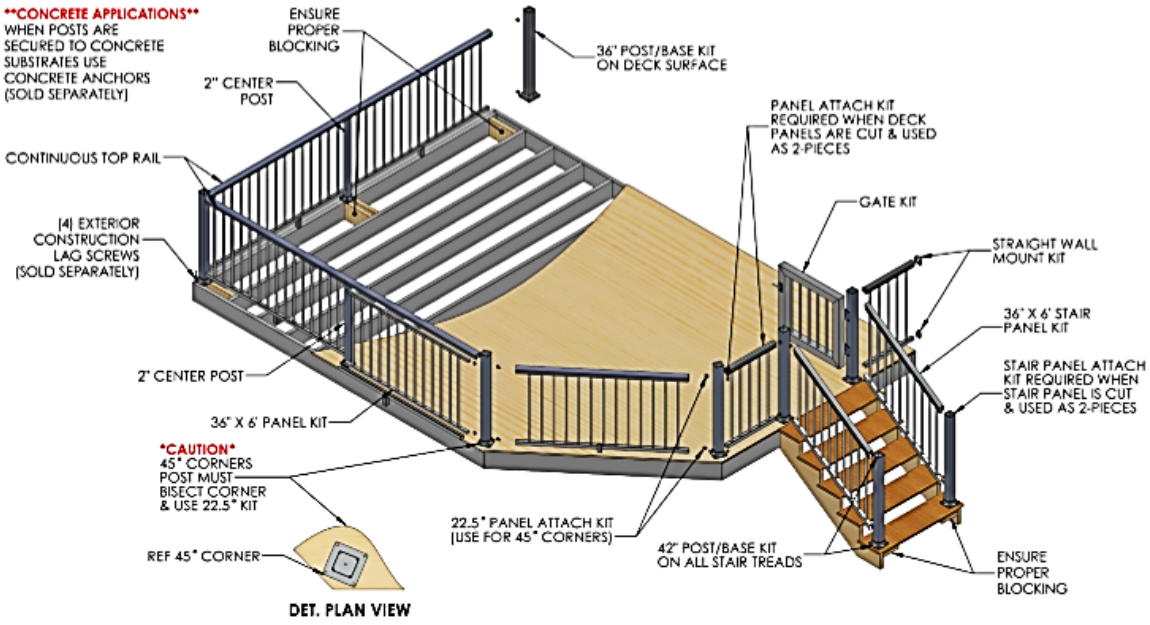
Standardization makes it possible to develop specifications and details for code compliant aluminum railings just once and then reuse those solutions, specifications and details in many projects. Master specification can be created with confidence, knowing an identical product will be delivered by a nearby fabrication facility, regardless of project location. Engineering support is also available nationwide for these railings.

Available Aluminum Railing Styles

Regardless of the selected style, the use of aluminum railings offers several project advantages. These include; ease of ordering, speed of fabrication, speed of installation, beauty, hidden fasteners, versatility for use anywhere and more than enough strength to meet requirements dictated by code.

There are many design choices with this railing material, in both contemporary and more modern styles. Aluminum can come in unlimited shapes, including custom extrusions if needed to meet design requirements. There is obviously a bit of extra cost in this, but it is not unusual for railing companies to have created numerous custom extrusions over time to produce requested products. There is also a much wider variety of stock sizes and shapes available from aluminum mills, than are available for use in carbon steel railings.

When seeking to use maintenance free products, aluminum is less expensive than stainless steel. This makes aluminum a strong choice when weighing initial costs against life-cycle costs.



Aluminum Railing Installation Diagram
Diagram provided courtesy of AZEK Building Products

Combined Aluminum & Composite Railings

As can be readily seen in the illustration above, railing systems are available using composite top and bottom rails with various infills, including aluminum pickets. Both types of railings are made with long-lasting components and consequently carry warranties longer than industry averages, some for as long as 25 years.

Aluminum and composite railing materials pair together well. Both composite and aluminum railings are known for color-fastness and durability. Both composite and aluminum railings are suitable for use in harsh and corrosive environments. They resist both corrosion and fading. Panelized systems available in each material save costs by reducing the amount of labor needed. This is a critical advantage in most parts of the country where there is a shortage of skilled construction labor. Extensive installation guides are provided by manufacturers. Gate kits are also available in both systems.

Glass Railings

When discussing glass railings, whether these are made of laminated glass or monolithic tempered glass, what is being discussed is infill panels of glazing. These panels can be held in place between posts, between top and bottom railings, or inside frames held in place by other railing components. They can also be frameless panels, held in place by spider fittings attached to posts. These glass infill panels, used in place of a balustrade, have become a popular and modern aesthetic look for buildings. This is because the glass railings give a building a much sleeker and more modern look, while giving residents of the apartments much better, more unobstructed views.

Monolithic glass is defined as a single thickness of glass that has been heat treated to temper it. Rather than installing sheets of glass that could act as guillotines if they began falling, monolithic tempered glass was specified for projects. If tempered glass failed, it would shatter into very small pieces that would then fall. If such a monolithic glass rail was mounted on top the slab, the pieces would usually fall onto the slab. If glass panels were mounted outside the slab, they would generally not be of tempered glass, but rather of laminated glass. Laminating material between glass sheets would still adhere to the shattered glass fragments and hold them in place. This is because even small pieces of glass, falling a long way, can be dangerous to people below.

Because of this still inherent danger, whether tempered or not, monolithic glass is currently being phased out by almost all codes. Monolithic tempered glass can still be used in NYC, but all other jurisdictions mentioned in this course have banned it. It can still be used in interior applications where the walking surface below is protected. NYC currently permits some use of monolithic glass but will likely require use of only laminated glass in the next code revision, whenever that occurs. IBC and all other states now require laminated glass for outdoor use. Some types of glass balusters are required to have top caps or handrails incorporated in their design, if and when tempered glass can still be used.

Laminated glass is essentially a glass sandwich, using a minimum of two glass sheets laminated to an inner layer. That inner layer can be various materials and can be clear, obscure or even acid-etched. A soft flexible plastic inner layer called PVB (poly vinyl butate) is used in some laminations and is available in many colors. PVB is soft and flexible and adds no structural capacity or capability to the glass sandwich. PVB should only be used if all four edges are trapped and sealed. Otherwise, discoloration will occur when the PVB is exposed to water or weather and over time, the glass sandwich will even delaminate.

In the event of a failure with a laminated system, even with a PVB lamination, pieces of both outer sheets of glass will stay adhered to the inner layer. If properly captured and encapsulated by other railing components, the whole damaged laminated sheet will stay in place till a replacement can be installed. But if only minimally held in place and the glass is adhered to the soft PVB inner layer, the weight of the glass can pull the now flexible sheet out of the frame and its attachments. This results in the shattered but still laminated glass sheet, leaving the frame and falling below.

To prevent this from occurring with glass panels not completely captured by frames, a better type of laminated glass has been developed. SGP (sensory glass plus) has a rigid inner layer, relatively new to the railing world. It does add some structural capacity to the sandwich and edges can be exposed to the elements in more open mounting systems. If both sheets of glass fail, the panel will stay in place because the inner layer of SGP has enough strength to continue to support the whole panel in the frame, until the glass can be replaced. This is especially true if the glass laminated to each side of the rigid plastic layer is tempered. Given its extra strong core, SGP laminations will also stand up to wind-blown debris that would just shatter tempered glass railings.

There are still only a limited number of suppliers, so obtaining panels laminated with SGP does require a long lead time. Tempered glass can be obtained in a week. Obtaining SGP laminations is taking five to six weeks. Nonetheless, since the technology is available, the use of SGP laminated glass is already being mandated by codes in certain windy areas.

Long lead times, and the need to quickly replace damaged panels, makes one additional precaution applicable. If feasible, when building new construction, attic stock for replacement railing panels should be purchased and stored somewhere on site for quick availability.

Bronze Railings

Having sources for bronze railings is especially important when dealing with historic restoration projects. This material was often used in grand public projects and one key consideration in maintaining public interest and backing for restoring such buildings, is retaining the original architectural character. Replacing well-known and beloved ornamentation, especially components as public as railings, becomes of critical concern. More will follow on this later.

Review Questions 3:

10. Disadvantages to the use of ferrous metals for railings include _____ .
    a. Corrosion
    b. Weight
    c. Both of the above
    d. Neither of the above

11. Composite railings are primarily used _____ .
    a. In residential applications
    b. In areas requiring non-combustible materials
    c. Around high-rise terraces

d. As divider panels

12. Aluminum is _____ than stainless steel.
    a. More expensive
    b. More durable
    c. More difficult to ship
    d. Less expensive

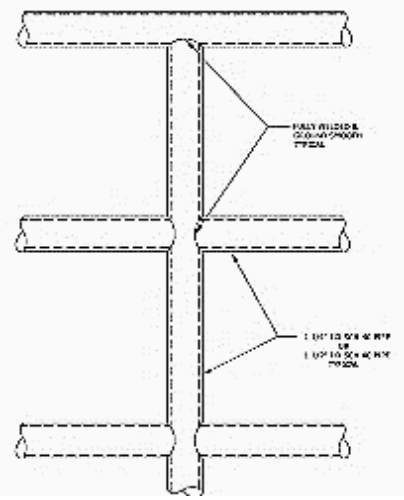
13. Monolithic glass is a single sheet of glass that has _____ .
    a. Had the edges fused to resist breakage
    b. A reflective coating to reduce glare inside
    c. Been formed from multiple sheets fused together
    d. Has been heat treated to temper it

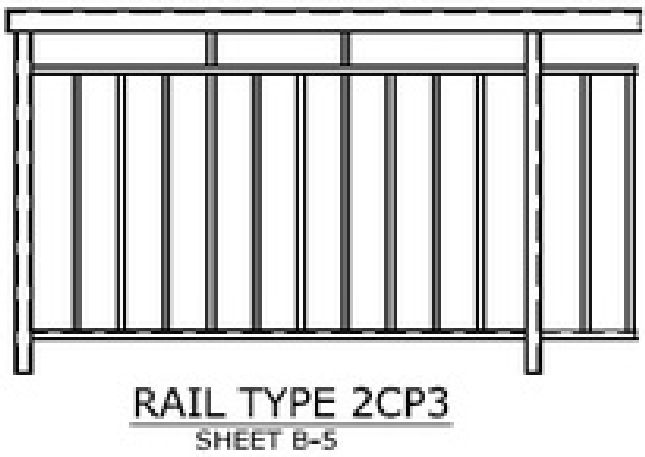
14. If a sheet of monolithic glass is mounted on the outside of a balcony and it shatters, the pieces can be expected to _____ .
    a. Fall onto the balcony
    b. Remain adhered to the top and bottom rails
    c. Fall down the side of the building and land below
    d. Do nothing since monolithic glass won't shatter

15. A new type of laminated glass has been developed, designated as _____ . It's core is a rigid sheet of plastic, which stays in the frame and to which broken pieces will still adhere.
    a. RPS
    b. SGP
    c. PVC
    d. IBC

Choosing Railing Design

Pipe railings are exactly what they sound like. They are round metal extrusions (pipes), welded together to create fall protection. They are sometimes in horizontal lines, welded in place about 4" apart. This is a poor idea, as that also forms a ladder easily climbed and fallen over. All the exposed welds used to fabricate pipe railings also give the completed rail more of an industrial look than is usually desired in a residential application.

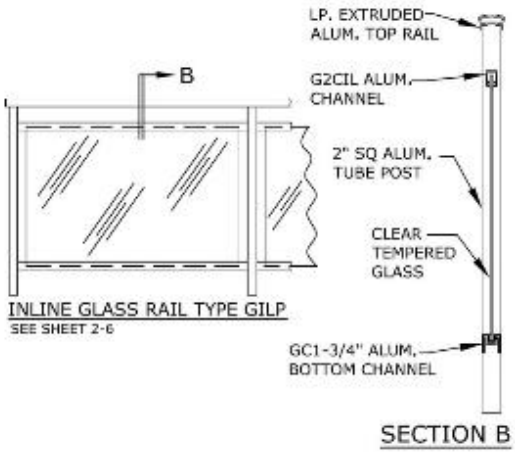


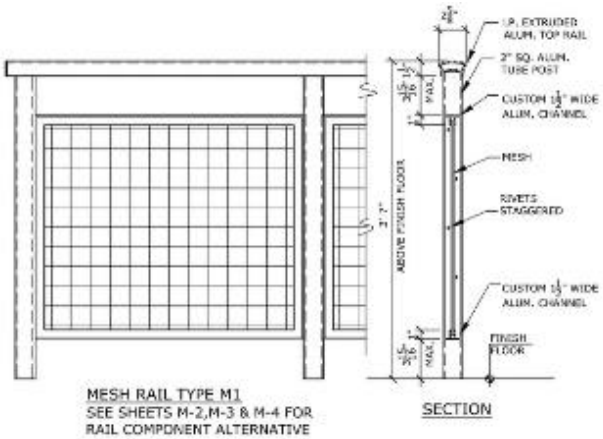


Pipe Rail Schematic Picket Rail Schematic
Schematics provided courtesy of S&S Manufacturing

Pipe railings can also be formed as a picket rail system, using vertical members spaced 4” apart between top and bottom rails. This eliminates the ladder effect. If other extrusions are desired instead of pipe, those are available in many standard and many custom shapes. Railings can also be designed with picket style extrusions in which all welds will be hidden from view. Vertical pickets can use any shape of available extrusions, that meet mandated strength requirements. Many different aesthetics become possible, but the basic system will remain as top and bottom rails, infilled by vertical extruded stiles. There is a good reason to specify such a system, even when a two-pipe railing would satisfy OSHA requirements. A picket system does far more to limit someone falling through, or someone pushing a larger object through the railing. With openings so limited in size, this design helps limit potential liability for the building owner.

We have already discussed glass railings, currently specified more often than other railing infills.

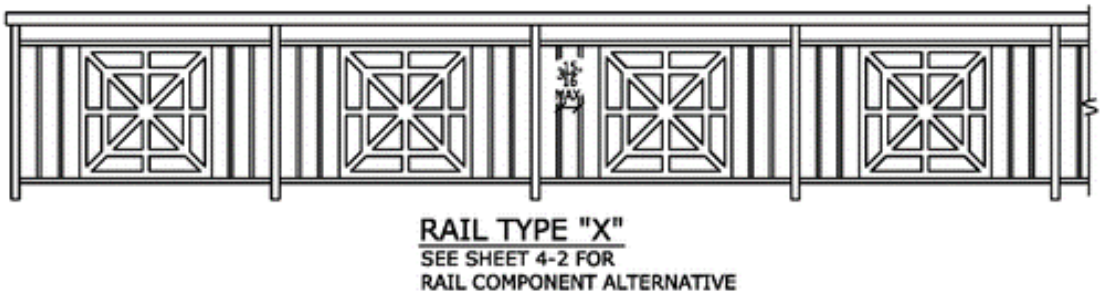




Glass Rail Schematic Mesh Rail Schematic
Schematics provided courtesy of S&S Manufacturing

Mesh, or perforated metal infill panels, are available in square mesh patterns or in solid panels punched out with round or square perforations.

X panel, or waterjet cut designs for infill panels, are limited only by the imagination of the designer. This is so long as no openings are created that allow too large a sphere to pass through or weaken the structural capability of the infill panel to resist mandated loading. The more complex the design, the more waterjet cut panels can be expected to cost.



X-Panel Rail Schematic
Schematics provided courtesy of S&S Manufacturing

The very specific look of cable railings is not common because use of them is somewhat problematic. Despite their sleek sexy look, deflection of the cables must be taken into consideration as cables expand and contract with heat and stretch out over time. More infill members are needed to overcome this limitation than would be required using solid extrusions. The ladder effect can also become a concern with these systems. Heavier corner posts and better wall connections are needed to mount cable systems, to compensate for cables pulling on and possibly bending end mounts, as cables are tightened or retightened.

Choosing Railing Finishes

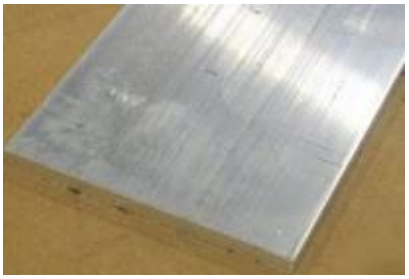
Options with Aluminum

There are many finish choices available with aluminum products. Anodized aluminum is available in clear, bronze, black or other finishes, with a clear finish by far the most utilized. Anodizing is basically a sped-up process of oxidizing the surface layer of the aluminum to a final inert state, resulting in a nice uniform finish to which no further changes will occur. Powder paint is an applied polyester baked-on finish that completely envelopes the metal. Powder painted aluminum is available in many standard and custom colors and results in a finish that in mild conditions, resists wear and tear better than Kynar coatings.

The lowest end of aluminum finishes is a mill finish. At this level, nothing is done to the aluminum material other than extruding it. The next step up in aluminum is the application of a brushed satin finish to it. Both a mill and a satin finish leave raw metal exposed to the environment, which is not really recommended for most applications. The raw material will continually oxidize until it obtains a white chalky surface. This chalky surface material will rub off on hands and clothes as a stain. Use of mill and stain finishes is acceptable in some industrial

settings. They can also be used in beachfront and boardwalk settings, where windblown silt and sand will speed up the oxidization process, almost creating a natural anodized finish.

An anodized finish on aluminum extrusions is the next step up in finish options. This clear finish allows you to see through it to the metal below. That metal is usually finished or polished prior to being anodized, to maintain the aesthetics of the material. As mentioned earlier, anodizing is basically a sped-up process of oxidizing the surface layer of the aluminum to a final inert state, resulting in a nice uniform finish to which no further changes will occur.


Mill Finish

Brushed Finish

Clear Anodized

Black Anodized

Powder Coated

Wet Paint

Aluminum Finishes
Pictures provided courtesy of S&S Manufacturing

Options for Stainless Steel

Choices for finishes on stainless steel are a bit more limited. They only consist of a brushed satin finish, a satin finish, or a mirror finish.

Brushed Satin Finish

Satin Finish

Mirror Finish

Stainless Steel Finishes
Pictures provided courtesy of S&S Manufacturing

Paint Finishes

Powder paint and Kynar paints are two finish options where an additional coating is applied to extrusions. As discussed earlier, powder paint is an applied polyester baked-on finish that completely envelopes the metal. Powder painted aluminum is available in many standard and custom colors and results in a finish that in mild conditions, will resist wear and tear better than Kynar coatings. Kynar coatings are a paint coat which includes a plastic component. Either coating is obviously prone to being scratched in unusual wear and tear situations.

The best-looking railings that have been installed, will not retain their appearance without regular maintenance. The best way to clean aluminum is with soap and warm water. No harsh chemicals should be utilized. As mentioned before, stainless steel must also be cleaned regularly. If left on stainless steel, chemicals in the air from factories, other environmental contaminants or even ice melt from nearby stairs will cause surface corrosion. If the idea of keeping up with all that is overwhelming, there are professional metal maintenance companies who can perform scheduled cleaning services on a contract basis.

Review Questions 4:

16. Pipe railings with horizontal members between posts are not recommended since they can also function as _____ .
    a. Anchors for grappling hooks
    b. An impediment to rescue workers
    c. Clotheslines
    d. Ladders

17. _____ is not a finish option for aluminum.
    a. Mirror
    b. Brushed
    c. Mill
    d. Anodized

18. Additional types of paint coatings added to aluminum extrusions are known as _____ and _____ .
    a. Powder coating and Kynar
    b. Kynar and metallic
    c. Metallic and powder coating
    d. Rustoleum and brazing

MARKET SHARE

Railing markets are mainly defined as single family residential, multi-family low rise and multi-family, high rise. Recent trends in material indicate:

- Most residential railings are still being made of natural wood on site.
- Seventy percent of railings used in commercial projects are top and bottom rails with picket infill systems.
- Top and bottom rails with glass infill panels have been used extensively in the past, but their popularity seems to be waning somewhat.

CHOOSING PRIVACY DIVIDERS

Privacy dividers are vertical panels sometimes installed to define user space or provide privacy when an outdoor area, terrace or balcony is being shared between two or more users. Such dividers can also be used on rooftops to hide mechanical equipment or delineate public from mechanical spaces. In addition to matching or mimicking the design of nearby railings, privacy dividers can be created in sizes and designs, and from materials limited only by imagination. This is because there are no real code requirements that must be satisfied in their design.

With one exception, there are no mandated heights for privacy dividers, other than what is needed to meet the building owner's intent in including dividers in their project. That exception is the previously mentioned new interpretation of NYC zoning law, sometimes used to restrict divider height to 3'-8". Under that ruling, a divider separating shared space will obviously not result in actual privacy, regardless of its composition. It will only define territory.

Privacy dividers are not load bearing structural installations, whereas guardrails do function as such. But designing their attachments strong enough to prevent privacy dividers from tearing loose and becoming airborne is always a good idea.

There are sometimes occasions when roofing or waterproofing has already been completed and a divider still needs to be installed, without penetrating a completed floor surface. In these cases, side connections can be custom designed for a small balcony environment, so a divider can be installed without compromising the waterproofed surface below.

Dividers with Solid Panels

Solid infill panels set into divider frames can be of metal, composite aluminum panels, wood slats, PVC decking or translucent lite panels. Even with solid panels, degrees of privacy range from complete privacy to partial visibility. Acid-etched or sand-blasted glass are infill panel options that are solid, but still offer varying levels of privacy. Wood is a poor choice for infill panels, due to its flammability and necessary ongoing maintenance to prevent rotting. Aluminum dividers with non-flammable infill materials will last much longer over time.

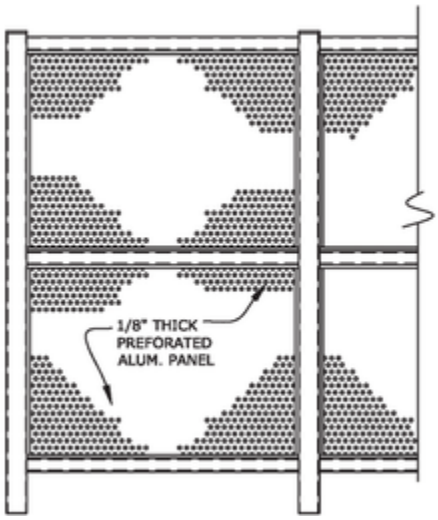
Solid Panel Divider

Solid Panel Divider

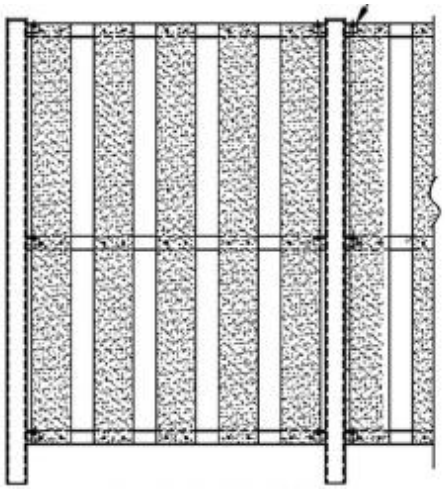
Photos provided courtesy of S&S Manufacturing

Dividers with Openings

Infill panels for such dividers can also be created using louvers, slats, tubes or perforated panels. While having openings somewhat compromises the degree of privacy provided, penetrations can also reduce horizontal load stress on the panels by allowing more wind to pass through without encountering resistance. Created louvers can be horizontal or vertical. Slats can be made of flat bar aluminum, aluminum tubes, wood or PVC decking. The spacing of the slats and the amount of stagger between them can also be varied, from a tight overlap to a wider gap to allow the passage of more air and light. Light and air transmission can also be accomplished using perforated panels. Even with openings, perforated panels can create an aesthetic that is desired on occasions.



Perforated Mesh Divider



Aluminum Slat Divider

Schematics provided courtesy of S&S Manufacturing

Attachment points for privacy dividers can be created on floors, ceilings, walls and sometimes even abutting railings. If so, the load on the railing must be calculated to verify it does not compromise the mandated railing capacity. Attachments to ceilings become possible only when there are balconies overhead.

Should dividers be created and shipped, knocked down or fully assembled? This can be partially answered by the fact that dividers are usually one of the last components installed in a building. If they cannot physically be brought through a completed building while totally assembled, they will need to be knocked down into smaller components and assembled and installed out on the balcony or other shared space.

Gates in privacy dividers are normally only required for maintenance purposes, when they are separating a private space from a public space like a mechanical area.

DESIGNING AND MOUNTING RAILINGS

It is very important to design proper mounting details for existing or new conditions in locations where railings will be installed. The best railings will fail, should the connections that are used be inadequate to also resist applied loads required by the code.

In renovation projects, this investigation begins with documenting the existing structure. Considerations for how to attach new railings will include determining how and where previous railings were installed. Details and design of new mounting solutions will need to take many considerations in mind. For example, should new connections align with or avoid, previously core-drilled holes? Should coping stone joints, expansion joints, mortar joints, etc. be utilized or avoided? What are the strengths and weaknesses of existing materials where attachments will need to be made? If they were damaged or compromised by previous railing attachments, can existing building materials at connection points be repaired or should other attachment points be used? These and other such questions should be examined and resolved before a choice is made as to how and where new attachments will be made.

Care should also be taken that railing attachments do not create weak points in the intended water resistance of the building envelope. If water can enter the façade at the point of railing attachment, further degradation of the area surrounding that attachment will occur. It will do so quite rapidly in climates with freeze/thaw cycles. Once the substrate to which a railing is attached has deteriorated around the anchors and their fasteners, which will be unknown to the building occupants, that railing is no longer actually anchored to the wall or base. That situation is a sure recipe for disaster.

Attachment methods must include considerations to resist such water penetration. Water cannot be allowed to settle into pockets created at points of connection. If water can enter, it must also be given a permanent means to drain. Otherwise expanding ice can seriously compromise the integrity of the slab, deck and walls holding the railings in place, dangerously weakening the connections themselves.

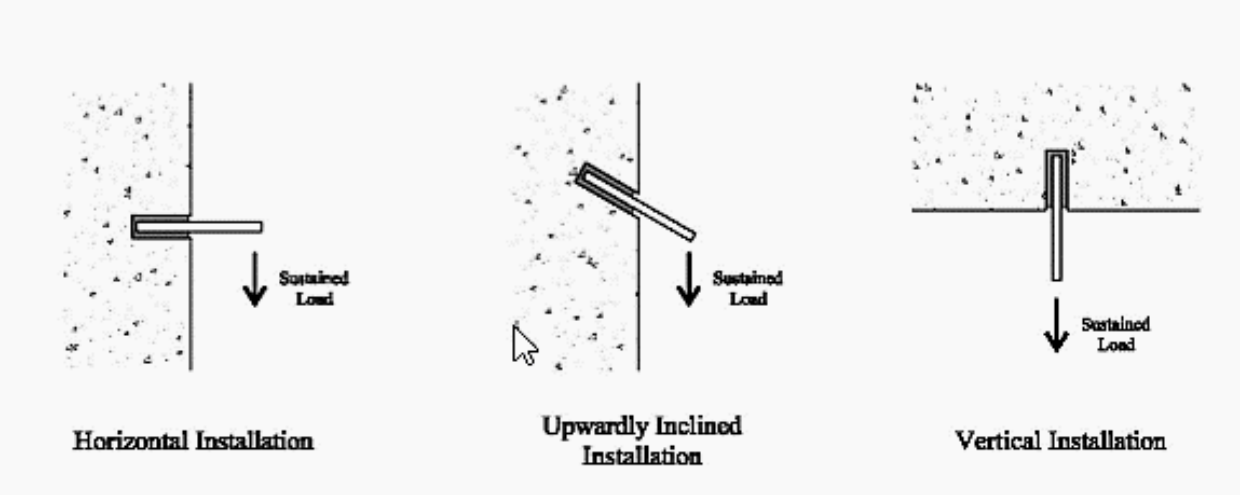
There are two primary classes of railing mounts to consider. One is attachments at the base and the other is attachments of a railing to a vertical surface.

Mounting at the Base

Railings can be mounted at the base with a top mount, utilizing a sleeve, base plate, flange / mandrel or a combination of these. Attachments can be made with penetrations into the slab or other base surface, whether with core-drilled holes or pre-set sleeves in new construction.

When a railing post needs to be set down into a hole, metal sleeves are an option, whether cast in place or bolted down to the concrete. When embedded sleeves will be used, they need to be pre-designed and pre-manufactured with continuous spacers used to install the sleeves. That way, spacing from one set of anchors to the next will be consistent and the completed railing system will fit on them after the fact. When such sleeves are bolted down in an earlier phase, placing roofing or setting pavers can be completed around the sleeves before railings or dividers are installed. In this way, work flow of the overall project will not be interrupted by the railing installation.

When adhesive anchors will be installed, certification of the installer and inspections of their work are required by NYC, as well as inspections of the installation process. Anchors in horizontal, upwardly inclined and vertical installations are subject to the requirements of such laws.



Different Anchor Orientations
Excerpted from NYC BUILDINGS BULLETIN 2015-027

Testing requirements for such anchors are also spelled out. The verbage below comes from the same bulletin as above.

"C. Alternative procedures for installer certification requirements. As an alternative to certified personnel in accordance with Section B of this bulletin, adhesive anchoring systems identified in Section A of this Bulletin shall be accepted if (a) explicitly qualified in accordance with Buildings Bulletin 2014-018 through an evaluation report based on ACI 355.4 or ICC-ES AC308 for horizontal or upwardly inclined positions when anchors are supporting sustained tension loads, (b) installers are trained under a manufacturer based installation training program covering the proper installation techniques for specific applications to be encountered under part A of this Bulletin, and (c) proof load tested in accordance with the following procedures.

The alternative procedures identified in this bulletin will not be accepted in lieu of certified personnel after September 10, 2017.

1. Sample size. A minimum of 20% or three tests, whichever is greater, shall be randomly selected and tested for each of the following conditions: -

i. Adhesive type.
ii. Anchor size.
iii. Embedment depth.
iv. Specified concrete compressive strength.
v. Installer working shift.

2. Testing Personnel. Proof load testing shall be performed by a special inspector or an independent testing agency employed by the owner or owner's representative.

4. Applied proof loading. The following shall be required for all testing:

i. Testing shall only be performed on adhesive anchoring systems installed in accordance with the Manufacturer's Published Installation Instructions (MPII)
ii. Anchors shall be subjected to confined tension tests.
iii. Proof loads shall be established in accordance with the following:

*a. Unless otherwise directed by the engineer or design professional of record, proof loads shall be applied as confined tension tests. Proof loads shall not exceed the lesser of 67 percent of the load corresponding to the nominal bond strength as calculated from the characteristic bond stress for uncracked concrete modified for edge effects and concrete properties or 80 percent of the minimum specified anchor element yield strength (Ase,N*fya).*
b. For anchors located close to edges, proof loads shall be adjusted as appropriate to avoid edge distance breakout failure. For closely spaced adjacent anchors proof loads shall be adjusted as appropriate to avoid premature failure.
c. The required proof loading for anchors installed under continuous special inspection performed in accordance with an evaluation report may not be used to satisfy the requirements of this bulletin unless all requirements from this bulletin are duplicated in the continuous special inspection proof loading program.

5. Acceptance Criteria.

i. Anchors shall resist the applied proof load (section (B)(4)(iii)) for duration of one minute without visual movement of the anchor or reduction on applied load as measured by test gauges.
ii. The registered design professional who designed and specified the anchoring system(s) shall be notified immediately if an anchor fails to satisfy the criteria in section (B)(4)(iii) of this bulletin. In such case, anchors in the subject sample size shall not be loaded until authorized by the registered design professional of record.

As can readily be seen by the language of the building code cited above, design of railing anchors and connections is of great concern to properly satisfy mandated loading requirements for railings.

Mechanical anchor bolts can be expansion bolts or sleeve anchors. Caution is needed when using mechanical anchors that are of an expansion type. These create additional lateral loads on the sides of whatever materials they penetrate. If installed near the perimeter of a slab, that added pressure sometimes results in concrete edges breaking off. For this reason, if a design requires railings being fastened close to a slab edge, epoxy anchors are recommended to avoid the potential of material fracturing from mechanical expansion anchors. Also, when expansion fasteners must be placed very close together, the stresses they create in the slab can interact with one another. In those cases, epoxy or adhesive fasteners are also recommended over expansion anchors.

A major concern arising whenever a post is grouted into a hole, is water penetration into that cavity. Internally, this moisture can be addressed by either:

- Weeping the formed hole at the bottom
- Filling the post with a BASF master-inject product to prevent condensation from forming inside the post and draining into the opening in the slab
- Utilizing a solid post in which no condensation can form.

The goal is to prevent water from draining into the post cavity in the substrate and sitting there during freeze-thaw cycles. That water will expand and cause failure of the substrate.

Filling penetrations in a substrate entirely full of grout is an external solution to the problem. This approach works by eliminating filling and eliminating any voids in which moisture could possibly settle.

When top mounting is done using grout, there are certain considerations best kept in mind.

- When grouting penetrations, a gypsum grout is never suitable for exterior use.
- Cementitious grout is suitable for embedding stainless steel posts.
- Cementitious grout will typically max out at around 8 ksi of compressive strength.
- A recent recommendation by different aluminum manufacturers is that cementitious grout should never be used to anchor aluminum, even when the aluminum member has been coated. If electrolysis occurs, it can corrode the metal and crack the grout.
- There are different types of epoxy grouts which can also be used, depending of the degree of strength needed and curing time desired before railing installation.
- Epoxy grouts can achieve significantly higher strengths of up to 15 ksi of compressive strength and are they safe and suitable for use with aluminum.
- Epoxy grouts are safer for use with all materials. If not using epoxy grout, you need to coat the part of the post in contact with the grout with some barrier material to protect the post, whether the barrier is of powder paint or bituminous coating. A thin epoxy coating is sometimes used on posts to create this barrier.
- Epoxy grouts are also more durable and do not expand like cementitious grouts will. When such expansion occurs, it exerts more load on the sides of the penetration, much like expansion anchors.
- Epoxy grouts do cost more in the original installation.

Mounting on the Side

Railings are often attached to the sides of brick, CMU or concrete walls. Such mounts will be bolted onto the side of the building utilizing either adhesive or mechanical anchors. On new construction, anchors can be embedded in the wall ahead of time, as either an embedded weld plate to which other anchors can be welded, or even as physical anchors left projecting from the wall. Such embedded items need to be pre-designed and pre-manufactured with a continuous spacer template provided, so spacing from one anchor to the next is consistent and the railing system will fit on them when it arrives. In renovation projects, side mounts are anchored differently, based on existing materials to which they will attach.

Adhesive, or epoxy anchors, typically have higher load capacities and are recommended when mounting into red brick masonry. Since these anchors remain somewhat liquid for a short time, these are not suitable for overhead fastening. Adhesive anchors do not in and of themselves, impart any additional loading into or onto the structure, once they are set and have bonded to the substrate.

Mechanical anchors are faster to install and cheaper than adhesive anchors and can be used for overhead applications when installing dividers to a slab above. As mentioned before, mechanical anchors of an expansion type will create additional lateral loads internally in what they penetrate, sometimes causing nearby material to shear off.

Determining Anchor Strength

Since these are potentially the weakest link in a railing installation, it is important to know how much force railing mounts will really resist and how secure they really are. Engineering values used for anchors are generally provided in published engineering data supplied by the anchor manufacturers. That data is used to calculate what those anchors will hold in terms of load resistance. Such provided values are usually very conservative to allow for potential installer error. This caution is justified by a history of failed installations, before stringent inspection programs were put in place.

One way around designing with low values provided for fasteners is the use of on-site anchor pull-out tests. In these, the anchor manufacturers physically come to the job site, install their products and pull a load on them, to determine their actual capacity on that specific job site, and with those specific wall and floor assemblies. The actual results of the pull-out test can then be used, supplemented by a factor of safety, to design a railing system using the tested fasteners.

Certain anchoring systems require holes to be drilled and anchors installed before the railing is available to put in place. These are female drop-in anchors that receive a male bolt to hold down the railing, once it arrives. Since the hole in the slab is significantly larger than the hole in the railing's base plate, they can't drill straight through. So a little additional field labor is required to install those type of anchors. Epoxy used in these systems also requires a certain amount of time for the epoxy to set up, before it can be loaded by the installed railing system.

When connecting top and bottom railing components, welded connections are preferred. But mechanical connections between parts of railings can be designed and provided, should a top or bottom rail need to be removable for rigging the roof with scaffolding.

Welded railings are much more durable than mechanically fastened railings. In a mechanically fastened system, you are relying on fasteners to maintain their tightness for the life of the project, despite vibrations and thermal expansion and contraction. Over time, mechanical fasteners will begin to loosen and fail. Welded connections are subject to the same forces on them but use solid connections that cannot loosen.

The major drawback in welding railing components together is what engineers call the heat effective zone. The heat from the welding process reduces the strength of aluminum for an inch in each direction from the weld. Being reheated causes nearby material to lose the strength it initially gained from being tempered. That loss in strength from being welded must be factored into the railing design.

Additional Railing Design Considerations

Expansion joints are sometimes needed in long lengths of railing, as when they are following the perimeter of a roof. Periodic expansion joints allow expansion and contraction of the railing system from season to season. The amount and spacing of such expansion joints are dictated by both the railing construction, and the construction of the building to which the railing is mounted. The building may expand at a different rate than the railing.

Review Questions 5:

19. In most cases, code requirements for privacy dividers dictate _____ .
    a. Nothing about them
    b. Size and attachment requirements
    c. Degree of privacy achieved
    d. That tenants provide maintenance

20. _____ is not one of the typical rail anchor orientations.
    a. Horizontal installation
    b. Upwardly inclined installation
    c. Downwardly inclined installation
    d. Vertical installation

PRODUCT STANDARDIZATION

When wood is the primary material for railings, fabrication typically occurs on site with no consistency in workmanship or quality of the wood used from project to project. This essentially made every wood railing a custom project.

Historically, every metal railing job also had to be treated essentially as a custom job. Railings were designed, with or without input from a local fabricator. Finished designs, specifications and details were sent out for bid by general contractors. The successful bidder for the railings would generate shop drawings, fasteners and engineering reports for what they would be providing. Once the project was greenlighted, manufacture of the railings by the local fabricator would begin. Fabricated railings would be installed by a railing subcontractor or the general contractor. When the work was complete, a warranty would be given for the railings by the local fabricator. This warranty would typically be good for a year.

Advantages of a Standardized Product to a Project

Realizing the need for a manufacturer with a national presence and standardized product offerings, some consolidation is beginning to occur. It is happening through mergers of manufacturers with expertise in differing railing systems. Eventually, hopefully, we will see larger suppliers offering every type of railing system. The only exception will be in the supply of wood products for use
.
With one such consolidated group, all materials and fasteners to be used in aluminum railing systems are made in a single location to assure consistency. They are then shipped for fabrication to more localized dealers who assemble them for specific projects. Those more local licensed fabricators use only materials from the central source. The intel for the manufacturing process is also inside the fabrication machines they purchase from the central source. The fabrication machines assemble standard railing system components into panels, customized for specific projects. This system greatly diminishes lead times needed to get products both made and delivered. They are used to create products that match and meet a reusable set of specifications, as well as locally enforced codes.

The key advantage to this approach is the development of systems and standards. Railings are engineered as a system and go together on site systematically, using concealed fasteners. This system speeds up installation, reducing labor costs. The specific fasteners needed for the requirements, substrates and environments of projects, the selection of appropriate fasteners and the supply of the same comes from the central location. No outsourcing of materials or fasteners by fabricators is permitted by the central source, insuring a consistent product offering across the nation.

Another key advantage is consistency. All railings, whether offered in composites or in aluminum, are compliant with the IRC and the IBC. Composite polymer railings are also essentially sold as standard components, to be assembled on site in a somewhat custom installation. Aluminum railings using pre-assembled panel sections can be sold like a kit, to be assembled at pre-measured and pre-determined locations. Consistency in product and method of

installation makes life easier for installers as well. Solutions to challenges faced by others have been documented and are already available to review and possibly implement.

Advantages of a Standardized Product to an Architectural Firm

There is a big difference in dealing with manufacturer on a national scale and one on a local scale. Warranties work best if a manufacturer is large enough to back them and will still be in business should they be called upon later to honor such a guarantee. Local fabricators, whether by changing names, retiring or simply going out of business, can quickly make any guarantees given for completed projects quite worthless.

Speed is another advantage usually offered by a larger fabricator. Machine assembly of standard components makes product quickly available for powder coating. This greatly reduces delivery time to the project. Different local fabricators can produce the exact same code compliant railing in New York as in California, with extremely short lead times in each instance.

Sustainability of materials increases when production occurs from a central location. Using a centralized supplier means no VOC's will be released on site during a finishing process. Whether aluminum, composite, or a combination of both, these railings are sustainable products. Aluminum is a highly recyclable product, as is the polymer used in composite systems. Even new composite railings are made using at least 50% recycled materials.

When one source is involved, it is easier to establish that all railings offered will meet the safety standards and loading resistance required by codes.

Larger manufacturers can also supply resources to architectural firms, offering support to make specifying their product easy. They should offer easy access to specifications from which to develop a master. If not already available, BIM files will soon be available to incorporate into 3D models, accessed and downloaded with no registration required to do so. 2D CAD files should also be available for download, with no required registration. There is a plug-in inside Revit that can search the web for specific BIM elements and incorporate them into drawings. 4specs.com is a good search engine to find needed specifications.

RENOVATION - REVIVING THE BEAUTIFUL

We've all been in buildings that hearken back to an older time. A common thought that runs through our minds is, "This is amazing! They sure don't make them like this anymore." In cases of disrepair, the thought might be, "I bet this was beautiful in its time, but who could afford to build like this now? Who could even afford to restore it now?"

Picture provided courtesy of
Livers Bronze

There is a basic problem with such restoration projects. Many of these lovely structures come nowhere near to meeting current building codes and guidelines. Since owners of existing buildings have no legal mandate to keep them current with new laws, motivation for upgrades becomes dictated more by marketing concerns than code enforcement agencies. But given an aging population of users, revisions allowing better access to buildings for this growing market segment are being considered more frequently. Considerations for, and ways to accommodate such access, are easily found in federal guidelines known as the ADA, the Americans with Disabilities Act.

With any desire to upgrade access to, or even the décor in our beautiful buildings from the past, comes the need for product sources. Can the bronze once used so prevalently still be found? Can anyone match the detailing currently found in a specific structure, especially detailing in railings that form so much of the visual appeal of grand staircases? Does anyone even make products like this anymore?

The surprising answer is that technology and manufacturers do exist to enable our desires to rehabilitate our beautiful buildings.

Issues Encountered in Historic Railings Replacements

Even when just replacing railings, code requirements must be met. There isn't much need for discussion there.

A question often arises when working on renovation projects, even those involving repairing and replacing railings. If the designation is possible, since some financial assistance might thereby be made available, should a building needing repair be registered as a historical structure? This is really a question for building owners.

Almost all financial assistance for renovation of historical structures comes with two caveats. Work desired for the renovation will have to meet design requirements established by the agency providing the money. And most such agencies require that all subsequent renovations to the building will need to be pre-approved by the agency offering that one-time financial assistance. With receipt of grant monies, control over future changes to the building will pass to some degree, to the agency registering the building and providing the limited funding.

Since code requirements often establish loadings that a railing must resist, then the strength of what is being proposed as a replacement must be verified as capable of meeting those mandates. Calculations are often provided by engineers or labs hired by the manufacturer, so the engineer of record for the building can be sure railings will properly withstand all imposed loads. When existing and new railing systems are connected with an infill panel between them, it can sometimes be difficult to establish compliance with loading requirements on those panel.

Older, grander structures with multi-story staircases, often utilized continuous railings which flowed seamlessly between both stairs and landings. These were probably fabricated in place. Repairing or replacing those will also likely involve on-site fabrication to some degree, especially if an attempt is being made to preserve the character of the original work.

There may be required handrail extensions to meet ADA requirements, but no apparent space in which to accomplish that. Either a great deal of creativity will be required, or if safety is not compromised by omitting them, an exemption will need to be sought from regulatory agencies from compliance with extension requirements in those cases.

Some railing components in place may have sustained damage. It will be difficult in many cases to match existing materials, profiles and extrusions that are simply no longer available. But some experienced and established fabricators may be able to use existing profiles to create matching sections and existing ornamentation to create molds to cast new pieces.

Sometimes, matching components can be cannibalized from less public areas to replace damaged ones in more public settings. Then newer, code compliant railings can be used to replace the cannibalized railings from which components were borrowed for the more public spaces.

It is likely that significant expense will be involved in duplicating railings still in place. The project owner will be called upon to decide how to proceed. This will be based on what quantity of needed railings involves new work, how much existing railing needs repaired and what portion can remain in place. Based on budget, it may be necessary to replace all railings with a design of stock components, intended to mimic what previously existed. The owner must be willing to attempt the feat and expense of duplicating older systems.

Attached to any renovation project is the difficulty of establishing the project scope (and subsequently the price) before work can begin. Without that, it is hard to count the cost. The same problems exist with railing repair and replacement. The best effort to establish an estimate involves documenting existing components in order to duplicate them, accurately plan for the project and determine project scope. Some fabricators have capabilities of high definition

surveying (like a total land station for buildings) to create a point cloud, from which a subsequent 3-D model of the project and its components can be generated.

Sources must be found for components that need replaced. A few rare firms still manufacture building components with old styling. Some businesses salvage and stock pieces from older structures being demolished, though luck plays a large part in finding needed components from those sources. If specific components are not readily available locally, they can sometimes be found internationally. As mentioned earlier, in perhaps a better option, some fabricators can use existing components for patterns and manufacture pieces to match. It is on specialty fabrication shops like this that the success of many renovation projects hinges.

Accommodating Historical Detailing

Historical details make and break the authentic feel of a restored building.

Picture provided courtesy of
Livers Bronze

Picture provided courtesy of
Livers Bronze

There are ways in which those historical details can be realized, especially in public areas. As mentioned before, existing railings and components from less public areas can be used to replace deteriorated components in more public areas. Then those cannibalized rails can be replaced with newer railing systems, similar in appearance to the old. In doing this, decisions must be made on what to keep and what to replace, based on extent and location. Existing components can be templates used in fabricating new components. Existing top and bottom rails can be saved and reused, but with new complimentary infill panels added between them.

In mixing and matching pieces, careful attention must be payed to compatibility of materials. Steel and aluminum in contact are a well-known problem. But bronze should also be separated from steel by Teflon spacers. Attention must also be paid to fasteners and connection points to the existing structure. The strength of any railing system is no better than the strength of its anchors. If possible, the design of the fastening system should also be consistent with the historical detailing.

If available, a fabrication shop should be brought in early with extensive capabilities and a shared concern for a professional job. Then as a team, the design goal can be pursued together. That will be the challenge of maintaining the previous look, despite the challenges.

Finding the right fabricator

It's a renovation project. Problems will come up and the scope will most likely not be completely pinned down. Choose a fabricator who understands that. They should have custom capabilities and be willing to use them, or sources and resources to provide what they cannot. Using a bit of a design-build approach, the fabricator should assume the responsibility to take their own on-site measurements and verify as-built conditions. Communication will be critical and a representative of the fabricator should be available for discussion whenever oddities crop up. The idea is to add fabrication capabilities, resources and tools to the team effort. Having a fabricator capable of generating 3-D models from point clouds taken on site, will offer a tremendous advantage in helping a building owner understand proposed solutions. Below are pictures of potential advantages offered by a collaborating fabricator.

Generating Cloud Points for a 3D Model
Picture provided courtesy of Livers Bronze

In-House Collaboration
Picture provided courtesy of Livers Bronze

Renovation Case Study

Interior renovations were needed for the Music Hall Municipal Auditorium in Kansas City, MO. Originally built in 1935, the renovations to it were handled by Piper Wind Architects.

Renovations to the building were spread throughout the project. They included extensive changes to doors, exits, railings, ramps, entrances, signs, etc., all intended to fit within the previous design theme and maintain the building's historical integrity. All the while, current ADA requirements needed to be met. The building was not registered historically, so the owner was still in total control of project decisions.

This structure contained a grand staircase where all railings needed renovated. Existing materials needing to be matched were of bronze. With no real excess components available and cost a real consideration, most existing railings were simply removed, refurbished and reused. The contractor did need to cannibalize existing railings in less visible locations for some parts. Regarding the railing potion of the project, the philosophy was, "Waste not, want not." Only one piece of the existing railings was deemed unfit for reuse and discarded.

The only thing publicly and obviously new in the stair and railing refurbishment, was the incorporation of new LED lighting under the railings.

Grand Ballroom
Picture provided courtesy of Livers Bronze

Music Hall Stairs
Picture provided courtesy of Livers Bronze

Music Hall Lobby
Picture provided courtesy of Livers Bronze

Little Theatre Foyer
Picture provided by Livers Bronze

Art Deco Chandelier
Picture provided courtesy of Livers Bronze

Music Hall Entry
Picture provided courtesy of Livers Bronze

Refurbishing railings in historically significant projects is a challenge few would care to tackle. Especially when current codes and ADA requirements must be met in the renovations. But the designers of the renovations to the Music Hall Municipal Auditorium would attest to this. Enlisting a quality fabricator to act as part of your team is a huge step in the right direction. That kind of relationship gives designers the agility needed to roll with punches and collaborate on solutions, as challenges inevitably arise in the project.

PARTNERS IN PROJECTS

What to Seek in a Supplier

- Absolute credibility
- Quality products
- Tested products
- Easily specified products
- Standardized products
- Affordable products
- Easily available product
- Speed of delivery

Distribution

Distribution capabilities are critical to product consistency, short lead times, and access to professional input on a project. There are distribution points like lumber yards, located across the country, for composite railing systems and their components. Many of them carry composite systems from central manufacturers. Such components come from a single source and in each location, are identical in size, composition, finish and cross section.

One railing system supplier maintains over 40 manufacturing locations across the country for aluminum railing systems. Identical machines use the same programming to produce the same products, but they are licensed to different trained and certified franchisees. The machines produce panels in standard eight- and ten-foot lengths, as well as custom sizes. This enables a central source to generate railings for different markets and different purposes in all locations. The machines use a patented railing assembly system, with the programming contained within the machines.

Such product consistency is a bonus to designers. These aluminum railing systems have an ICC report that is enough to satisfy code requirements for most smaller commercial projects. But the railing company also has engineers in house capable of providing a wet stamp for calculations, whenever and wherever that becomes necessary. People behind both composite and aluminum railing systems are available for technical expertise and assistance. Central engineering expertise performs necessary calculations and creates needed shop drawings.

At least one manufacturer is moving forward in becoming a one stop shop for all railing systems.

CONCLUSION

Designing and specifying railing systems for projects is becoming easier. Standardized details and specifications are becoming possible, requiring only minor variations to reapply and reuse them in new projects.

The key is to seek out and find the manufacturers whose products are created for consistency. Look for the value such companies bring to the table ahead of time with standard specifications,

code compliance, testing results, standardization, extensive product warranties and wide-ranging product choices.

Companies with expertise you can lean upon.

Review Question Answers

1. (The correct answer to this question is (b). Handrails and guardrails are distinguished by height but do require the same resistance to the width of objects passing through.)
2. (The correct answer to this question is (a). Most codes require a hand rail height of 36" AFF, but some permit as high as 38" AFF.)
3. (The correct answer to this question is (a). The Aluminum Design Manual lists tested strengths for different aluminum profiles and is usually directly referenced in codes.)
4. (The correct answer to this question is (a). This is generally accepted as being the diameter of a small child's head, and if the head can't make it through, neither will the child's body.)
5. (The correct answer to this question is (c). This guide establishes only safety requirements for employees in workplaces)
6. (The correct answer to this question is (c). Outside agencies, whether testing labs or engineering firms, are accepted as credible unbiased sources.)
7. (The correct answer to this question is (b). Engineers certifying designs for railing connections do not accept responsibility for existing or even new substrates, something over which the certifying firm has no control)
8. (The correct answer to this question is (d). When concerns or problems arise with imported products, usually those involved tend to claim the problem originated further up the supply chain.)
9. (The correct answer to this question is (d). All the other methods for strength testing are mentioned in the narrative.)
10. (The correct answer to this question is (c). Rust is an ongoing problem with iron railings and much of their expense lies in the cost of shipping them, due to their weight. Their weight also creates additional expense in labor needed to install them.)
11. (The correct answer to this question is (a). While it is possible to use them in commercial applications, most composite systems are still railings, used in residential applications.)
12. (The correct answer to this question is (d). As aluminum is less durable than steel and easier to ship, the last answer is the only true statement.)
13. (The correct answer to this question is (d). Monolithic glass railing infills are tempered so that if shattered, they will disintegrate into small pieces, rather than becoming extremely dangerous falling shards of glass.)
14. (The correct answer to this question is (c). Mounted on the outside of a balcony slab, there is little to stop pieces from the panel from descending to the ground below.)
15. (The correct answer to this question is (b), with SGP standing for 'sensory glass plus'. The more rigid internal plastic layer provides a stable core which stays in place to support broken glass pieces, until repairs can be made.)
16. (The correct answer to this question is (d). While they can be misused as indicated in the other answers, the primary problem with horizontal pipe railings is that small children who like to climb, will climb and can easily fall over them.)
17. (The correct answer to this question is (a). All the other finishes for aluminum are listed as options except mirrored, because aluminum cannot be polished to a mirror finish)
18. (The correct answer to this question is (a). The only two paint finishes mentioned in the narrative as being used on aluminum are Kynar and powder coating.)
19. (The correct answer to this question is (a). While there is one minor requirement sort of listed in a code specific to New York, pretty much the only design considerations for privacy dividers are whatever the building owner requests.
20. (The correct answer to this question is (c). The three orientations for railing anchors are shown graphically in the narrative.)