



Minimum Construction Standards for Rehabilitation, Reconstruction and New Construction for Single Family Residences

Version 5.4

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Document Owner: Kevin Bingham
Owner's Division: Single Family
Owner's Title: Senior Project Manager

Lead Author: Jeniece Goudeau
Author's Division: Compliance and Grants Administration
Author's Title: Management Analyst IV

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DEFINITIONS

- A. American Disabilities Act (29 CFR Part 8 Subpart C):** The Americans with Disabilities Act of 1990 (ADA) prohibits discrimination and ensures equal opportunity for persons with disabilities in employment, state, and local government services, public accommodations, commercial facilities, and transportation. It also mandates the establishment of telecommunications device for the deaf (TDD)/telephone relay services.
- B. APA:** American Plywood Association
- C. CDX:** Veneer plywood which is manufactured by gluing and pressing together sheets of wood.
- D. Egress:** A permanent and unobstructed means of exiting from the home in an emergency escape or rescue situation.
- E. Energy Star Rated:** All systems, components, equipment, fixtures, and appliances that meet strict energy efficiency performance criteria established, as a joint effort, by the federal Environmental Protection Agency, the U.S. Department of Energy and the U.S. Department of Housing and Urban Development and that carry the Energy Star label as evidence of meeting this criterion.
- F. Fair Housing Act (24CFR§100.25):** Federal law that prohibits discrimination by direct providers of housing, such as landlords and real estate companies as well as other entities, such as municipalities, banks or other lending institutions and insurance companies whose discriminatory practices make housing unavailable to persons because of race or color, religion, sex, national origin, family status or disability.
- G. Form 14.27:** The Verification of Disability form that is signed or prescribed by a doctor during a Single Family program application intake process.
- H. Ground Cover:** Suitable material applied to the ground to prevent erosion of the soil and includes concrete, flagstone, gravel, asphalt, grass, or other forms of landscaping.
- I. Habitable Space (Room):** Space (rooms) within the home for living, sleeping, eating, or cooking. Bathrooms, toilet rooms, closets, halls, storage or utility spaces, and similar areas (rooms) are not considered habitable spaces (rooms).
- J. HC-1, HC-2, or HC-3 bathroom:** The level of physically challenged amenities as defined in the City of Houston document [Form 14.27 \(Verification of Disability Form\)](#).
- K. Homeowner:** The applicant and/or co-applicant who has been determined by the HCDD to have legal ownership interest in the property.
- L. Prospective Homebuyer:** An individual that is expected to purchase a home.
- M. Pest:** Any mouse, rat, bed bug, flea, wasp, hornet, cockroach, or other undesirable fauna.
- N. PVC:** Polyvinyl Chloride used for electrical insulation, films, and pipes.

- O. Rehabilitation of Non-substantially damaged homes:** Any reconstruction, rehabilitation, addition, or other improvement of a structure's cost DOES NOT equal or exceed 50 percent of the market value of the structure before the "start of construction" of the improvement. For the purpose of determining substantial improvement, market value pertains only to the structure in question. It does not pertain to the land, landscaping or detached accessory structures on the property. Any value resulting from the location of the property should be attributed to the value of the land, not the building.
- P. Rehabilitation of Substantially damaged homes:** Any reconstruction, rehabilitation, addition, or other improvement of a structure in which the damage of any origin sustained by a structure whereby the cost of restoring the structure to its before damage condition would equal or exceed 50 percent of the market value or replacement cost of the structure before the damage occurred.
- Note:** The cost of the repairs must include all costs necessary to fully repair the structure to its "before damage" condition.
- Q. R-value:** The measurement of how well a type of insulation can keep heat from leaving or entering your home.
- R. Sewage System:** The City sanitary sewer system or a private sewage disposal system approved by the City.
- S. Single Family Unit:** A one- to four-family residence detached or attached to other housing structures.
- T. Specifications:** Minimum acceptable grades and types of materials to be used and to provide the basis for how materials and equipment must be installed.
- U. Substantial Improved:** Any reconstruction, rehabilitation, addition, or other improvement of a structure, the cost of which equals or exceeds 50 percent of the market value of the structure before the "start of construction" of the improvement.
- V. TREC Inspector:** A real estate inspector licensed by the Texas Real Estate Commission to perform an inspection of a property.
- W. UFAS:** Uniform Federal Accessibility Standards
- X. U-value:** The rate of transfer of heat through a structure. The better insulated a structure, the lower the U-value.
- Y. Workmanship:** The quality of the work performed.

OVERVIEW

The standards contained in this document establish the minimum design standards for rehabilitation, reconstruction, and new construction for all single family housing units under the City of Houston's (COH) programs that receive assistance through federal funding from U.S. Department of Housing and Urban Development (HUD) Program and any other available local and/or state funding.

Any design standards not included in this document, must ultimately comply with the City of Houston's adopted residential codes and the funding agency residential construction standards, rules, and regulations.

The following standards will apply to all rehabilitation, reconstruction, and new construction single family housing projects. However, in circumstances where existing conditions require replacement with similar or substituted materials or products, those substitutes must meet minimum standards and submitted for approval by City of Houston Housing and Community Development Department (HCDD) prior to construction or installation.

These standards are issued by HCDD and apply to all communities within the incorporated City of Houston. These standards are not intended to reduce or exclude the requirements of any applicable local, county, state, federal building, housing codes, standards, or ordinances which may apply a more stringent requirement. In addition to these standards, construction activities must also comply with the following as applicable and subject to most stringent requirement:

- The International Residential Code (IRC) 2015 adopted by the City of Houston or the latest edition of the IRC and any applicable code required by the City of Houston¹.
- The International Energy Conservation Code (IECC) 2015 adopted by the City of Houston or the latest edition of the Model Energy Code (MEC) and any applicable code required by the City of Houston¹.
- The Lead Based Paint (LBP) regulations as described in 24 CFR Part 35 for units built before 1978².
- Applicable local, state, and Federal regulations for Asbestos Containing Material (ACM)
- Texas Department of Insurance (TDI) Windstorm Standards
- HUD Uniform Physical Condition Standards (UPCS)³
- HUD CPD Green Building Retrofit Checklist⁴
- Texas Government Code 2306.514⁵ – Construction Requirements for Single Family Affordable Housing

¹ The City of Houston latest adopted construction and model codes can be found at <https://www.houstonpermittingcenter.org/help/codes>.

² <https://www.ecfr.gov/current/title-24/subtitle-A/part-35?toc=1>

³ [111-Inspection Checklist.xls \(hud.gov\)](#)

⁴ <https://www.hud.gov/sites/dfiles/CPD/documents/CPD-Green-Building-Retrofit-Checklist.pdf>

⁵ https://texas.public.law/statutes/tex.gov/t_code_section_2306.514

- City of Houston, Texas, Chapter 19 Floodplain Ordinance, March 2018⁶
- City of Houston Contractor Performance and Specification Manual April 2014⁷
- Uniform Federal Accessibility Standards (UFAS)⁸
- UFAS Accessibility Check List⁹
- The requirements from other governing entities such as Homeowners Associations and Local and Federal regulations pertaining to zoning, traffic, drainage, flood plains and fire prevention – National Fire Protection Association (NFPA)
- Americans with Disabilities Act¹⁰
- Zero Energy Home Ready Guidelines¹¹

Preface

These standards within are designed to include and to expand on the national housing standards for the condition of HUD housing at 24 CFR Part 5.703. Many of the requirements and standards herein may exceed HUD’s national housing standards: to ensure that all residents live in safe, habitable dwellings, the items and components located inside the building, outside the building, and within the units of housing must be functionally adequate, operable, and free of health and safety hazards. This document further defines the common definitions of “safe, decent, and sanitary” housing; “non-luxury, suitable amenities” housing; and “good quality, reasonably priced” housing, that are affordable to persons and families that are low or moderate income. These standards are also designed to assist in achieving consistency throughout the City of Houston for single family rehabilitation, reconstruction and new construction residences funded with Federal, state, and/or local funding.

Through these standards, sustainable design principles have been incorporated to minimize negative environmental impacts and to promote the health and comfort of the occupants of housing reconstructed to these standards. Included herein are measures to reduce consumption of non-renewable resources, minimize waste, and to create healthy, productive environments. Standard measures have been incorporated herein relating to energy conservation, energy efficiency, water conservation, and indoor air quality. Also, materials and construction methods will emphasize resiliency, high quality, durability, sustainability, and water and mold resistant homes. These standards are also performance standards, for example, specifying units must be habitable and in functional condition with maximum life expectancy.

These standards assume a knowledgeable inspector will thoroughly inspect all components, systems, and equipment in each home, as referenced in this document. All systems must be in good working order, good condition, and capable of being used for the purpose in which they were intended and/or designed. These standards also assume the inspector will consider any

⁶ <https://www.houstontx.gov/council/g/chapter19/proposed-revisions-march23.pdf>

⁷ https://www.houstontx.gov/housing/rfp/COH_Contractor_Performance_Manual.pdf

⁸ <https://www.access-board.gov/guidelines-and-standards/buildings-and-sites/about-the-aba-standards/ufas#intro>

⁹ <https://www.hudexchange.info/resources/documents/Ufas-Accessibility-Checklist.pdf>

¹⁰ <https://beta.ada.gov/law-and-regs/ada>

¹¹ <https://www.energy.gov/eere/buildings/zero-energy-ready-homes>

extraordinary circumstance of the occupants in the home (e.g., physical disabilities) and reflect a means to address such circumstances for that home.

All newly constructed interior ceilings, walls, and floors must not have any defects such as bulging or leaning, holes, loose surface materials, buckling, missing components or other damage. The roof must be structurally sound and weather resistant. All exterior walls, including foundation walls, must not have any defects such as leaning, buckling, sagging, or defects that may result in the structure not being weather-resistant or that may result in air infiltration or vermin infestation. The condition of all interior and exterior stairs, halls, porches, walkways, etc. must not present a danger of tripping or falling.

For rehabilitation, the scope of work will be determined based on the existing conditions and the repairs/replacement to be performed. Depending on the damage incurred, the scope of work will conform to the minimum standards mentioned in this document. In addition, all construction activities identified in the scope of work must be performed in accordance with all applicable local, state, and federal laws and regulations.

Any single family housing units to be constructed or rehabilitated must be made accessible upon request from the prospective homebuyer or homeowner if the nature of the disability of the prospective homebuyer or homeowner so requires. This request must be supported by written documentation submitted by the physician of the prospective homebuyer or homeowner, and approved by HCDD prior to the implementation of construction or rehabilitation activities in accordance with Uniform Federal Accessibility Standards (UFAS).

All proposed site-specific and building envelope construction documents must be reviewed by a Single Family representative for compliance prior to submission to permitting.

Minimum Space Use and Location Requirements

- A.** Newly constructed habitable rooms, hallways, or bathrooms should not have a ceiling height of less than 9 ft. Rehabilitated homes must have ceiling heights that are code compliant.
- B.** The lot or defined site must be free of debris, garbage or other accumulations of site stored items that create possibilities of infestations. The site must be generally level, well drained, and accessible.
- C.** All habitable rooms, except kitchens must have a minimum length and width of 11'-0" ft. x 11'-0" or 121 square feet minimum.
- D.** Living rooms must be at least 120 sq. ft. in area, unless approved otherwise.
- E.** Bedrooms that are only accessible through another bedroom will not count as a separate room.
- F.** All bedrooms must have access to closets for storage of clothing and at least one escape window, as required by code.

G. If required based on neighborhood context, each new single family home must be provided either a one-car or two-car garage with an automatic garage door opener and two remotes.

- Each one-car garage must be a minimum area of 12'6" wide x 24' deep, and each two-car garage must be a minimum area of 20'6" wide x 24' deep, unless directed otherwise or approved otherwise.

Note: *Acceptable automatic garage door opener manufactures include Liftmaster, Genie, or an approved equal.*

- **Hazardous and Substandard Conditions**

These conditions must include but not limited to:

- Accumulated debris, waste, or garbage either in enclosed areas such as storage buildings or in yard areas.
- Deteriorated and/or irreparable outbuildings, sheds, wells, privies, or other structures that are no longer in use or are unusable by their condition.
- Holes, ditches, exposed meter boxes or other conditions that create a trip hazard excluding drainage ditches that are part of a designed drainage system.
- Rodents, insects, or other infestations; pre-emptive measures must be taken as necessary such as soil treatment (termite control), removal of nearby overgrown vegetation (vermin) to address such issues.
- Standing water or depressions that hold water.
- Exposed pipes, railings or other installations creating trip hazards.
- Damaged, missing, or deteriorated walkways, steps, and decks that create trip hazards or are otherwise unsafe.
- stairways or steps with two steps or more, without a functional rail.

H. General Standards

- All single family homes should incorporate resiliency solutions which may include elevating the first floor of the habitable area in accordance with Chapter 19 of the City of Houston Ordinance., breakaway ground floor walls, installation of reinforced fortified roof systems, use of Energy Star appliances and fixtures and the use of mold and mildew resistant products.

Minimum Standards for Basic Equipment and Facilities

A. Kitchen

Each home must have one kitchen equipped with the following:

- **Kitchen Sink**

The sink must be stainless steel (16-18 gauge), double bowl and connected to both hot and cold potable water supply lines under pressure and to the sanitary sewer

waste line. When installing such components, water supply shut-off valves must be installed. The sink must have minimum dimensions of 33 inches long by 22 inches wide by 8 inches deep with sink strainers, and food disposal unit.

Note: *Acceptable kitchen sinks must be Moen, Delta, or an approved equal.*

- **Dishwasher**

The kitchen must contain an Energy Star certified dishwasher in good working condition and capable of supplying the service intended. The color must be either black, white, or stainless steel, where all appliances match in color and brand. **Note:** *Acceptable dishwashers must be LG, GE, Whirlpool, or other approved brand.*

- **Oven and Stove or Range**

The kitchen must contain an exhaust hood, vented through wall or roof, and a minimum 30-inch-wide gas or electric range, unless otherwise specified by HCDD. The homeowner must have an option for an electrical or gas cooktop at no additional cost to the City or to the prospective homebuyer or homeowner. The kitchen may contain a microwave integrated with the range hood and the color must be either black, white, or stainless steel where all appliances match in color and brand. **Note:** *Acceptable oven and stove or range must be LG, GE, Whirlpool, or approved equal Energy Star appliance.*

- **Refrigerator/Freezer**

The kitchen must contain an Energy Star certified refrigerator/freezer, with a minimum of 18 cubic feet capacity, connected to the power supply, in good working order and capable of supplying the service for which it is intended. A refrigerator water line must be provided to accommodate any refrigerator upgrades. The color must be either black, white, or stainless steel, where all appliances match in color and brand. **Note:** *Acceptable refrigerators/freezers must be LG, GE, Whirlpool, or approved equal.*

- **Cabinetry & Counter Space Area**

Cabinetry must be factory built and pre-finished with plywood sides with recessed, shaker, or flat panel doors and drawer fronts. Cabinetry must also have face frames of hardwood construction, and veneer/ply toe kicks. Hardware consists of concealed hinges and side mount drawer hardware with soft closing glides. .

Counter tops in the kitchen must be solid surface with at a minimum 4" high back splash and side splash if required by plan or design. Waterproof around sink cut out perimeter top, edge, and bottom. Contractor to provide prospective homebuyer or homeowner with pre-selected color samples for color selection as shown on Material Selection sheet.

For the Single Family Home Repair Program, every kitchen must be equipped with a pantry with 5 shelves, 36" base cabinets and 36" upper cabinets.

For the single family homes developed under the Community Housing Development Organization (CHDO), the New Home Development Programs (NHDP), and the Affordable Home Development Program (AHDP) will be required to have a pantry with 5 shelves, 36" base cabinets and 42" upper cabinets unless noted otherwise.

- **Hazardous and Substandard Conditions**

- Lack of adequate food storage, food preparation area, refrigeration, or cooking facilities.
- Spaces that are so small as to be unusable or inadequate for their intended purpose.
- Lack of ability to clean.
- Defective cabinet door function and hardware, shelving condition, and secureness of the overall assembly to floor and wall.
- Damage or water penetration on base cabinetry when extended above the toe plate.
- Use of materials on Countertops that cannot be readily cleaned must be replaced.

B. Bathroom(s)

When a plan includes two or more bathrooms, 1 bathroom of the choice of the prospective homebuyer or homeowner must be large enough to be made handicap and wheelchair accessible for aging in place.

- Provide master bathroom and master closets in separate areas.
- All master bathrooms must have a linen closet or a 16" to 21" deep cabinet within or adjacent to the bathroom.
- All plumbing fixtures must be United States Environmental Protection Agency (USEPA) Water Sense qualified or better.
- When installing toilets, sinks, or such components, water supply shut-off valves must be installed.
- The toilets must not use more than 1.28 gallons per flush.
- Toilet throat size will be no less than 2 inches and glazed smooth.
- Unless noted otherwise, all bathrooms must have cultured marble countertops.

Note: Prior to permitting, the contractor must coordinate all bathroom designs conforming with a doctor prescribed Verification of Disability/ Special Need form.

- Unless noted otherwise, all newly constructed homes must include the standard shower/tub option with ceramic tile walls sealed or with self-sealing grout. Tub area only.
- All bathrooms must receive shower wands and must have a flow rate no greater than 2 gallons per minute (gpm). Shower wall construction must be such that grab bars can be added later by installing 2 inch x 6 inch blocking during framing.
- All bathrooms must have Energy Star rated or equivalent power-vented fans and must exhaust to the exterior.
- The wall construction adjacent to and behind all toilet walls must be such that grab bars can be added later by installing 2-inch x 6-inch blocking during framing.
- Vanities must be factory built and pre-finished with plywood sides and recessed, shaker, or flat paneled doors, drawer fronts, and face frames of hardwood construction. Hardware must consist of concealed hinges and side mount drawer hardware. Vanity a solid surface countertop and sink with integral sink 1/2" thick solid polymer material adhesively joined with inconspicuous seams, standard edge details with integral or undermount sink. A cove-shaped back splash and side splashes must be provided. The color is *pre-selected by prospective homebuyer or homeowner* and as indicated on Material Selection sheet.
- At a minimum, each bathroom must contain one 18" long metal towel bars, a toilet tissue holder, a wall mounted mirror equal to the length of vanity, and a recessed medicine cabinet. . All selected accessories must match in color and finish.
- All bathrooms must have doors with a privacy lock.
- When it applies, the prescribed HC-3 bathroom with a roll-in shower option, the bathroom must receive ceramic tile flooring, and floor to ceiling tile in the shower area only. Also, as it applies to an HC-3 bathroom with a roll-in shower option on a slab foundation, the contractor must depress the concrete floor slab, in the areas with drains to receive a sloped mortar bed. The slab should be dropped 3 ½" so that the plumber installs the shower liner, and the tile setter floats out the liner and slopes it to the drain. The 3 ½" allows for the thickness of the float, the thin set, and the thickness of the tile.

C. Hot Water Supply

Every home must have supplied water heating equipment (water heater and hot water supply lines) that are free of leaks, connected to the source of fuel or power, and is capable of heating water to be drawn for general usage. A 40-gallon gas water heater must be the minimum size provided in each home. The prospective homebuyer or homeowner may have an option of an electric water heater at no additional cost to the

City or the prospective homebuyer or homeowner. All water heaters must be installed to the manufacturer's specifications.

- No water heaters, except point-of-use water heaters, must be allowed in the toilet rooms or bathrooms, bedrooms or sleeping rooms. No gas water heaters must be allowed in clothes closets.
- All water heaters must be vented in a safe manner to a chimney or flue leading to the exterior of the home either through the roof or the side wall. Paint all penetrating roof vents and led jacks to match the color of the roof shingles.
- All water heaters must be equipped with a pressure/temperature relief valve possessing a full-sized, non-reduced, rigid copper or steel discharge pipe to within 6 inches of the floor. The steel discharge pipe must not be threaded at the discharge end.
- All water heaters must be installed on an 18-inch-high metal stand with a pan and include a Polyvinyl Chloride (PVC) drain tube leading to the exterior of the home. If the exit point is further than 24 inches, then a rubber hose is preferred, but not required.
- All water heaters must have internal foam insulation that is a minimum of R-10. Gas water heaters must have a uniform energy factor (UEF) rating of .62 or higher and a recovery efficiency of .75 or better. Electric water heaters must be Energy Star 3 or 3.1 rated.
- Where feasible, tank-less water heaters may be installed, with HCDD approval, in accordance with manufacturer's guidelines and sized to provide adequate hot water supply to all fixtures.
- All water heater closets must be completely sheet rocked, equipped with a fired rated door with threshold and self-closing hinges at the top and bottom. All vents must have a ceiling mounted flanged tightly secure and caulked.
- **Hazardous and Substandard Conditions**
 - Missing gas shut-off valve.
 - Missing water supply shut-off valve.
 - Combustion air taken from living area except when adequate air exchange meets Standard Building Code Congress International (SBCCI) standards.
 - Missing or dysfunctional Temperature/Pressure-Relief (TPL) valve.
Note: TPL drain must flow at an angle not exceeding horizontal and exhaust flow to exterior of building.
 - Inadequate exhaust pipe, combustion exhaust must be double walled and skirted at all penetrations.
 - Hot water heaters with storage tanks less than 40 gallons.
 - Pipes, nipples, or tank elements that are rusted or corroded.

D. Exits

All front entry doors must be 3'0" wide by 6'8" in height and must be solid core wood, steel, or insulated fiberglass doors. Doors should be fire rated where required by code or as approved by HCDD.

All rear entry doors must be 2'8" wide by 6'8" in height and must be solid core wood, steel, or insulated fiberglass doors. Doors should be fire rated where required by code or as approved by HCDD.

Every exit from every home must comply with the following requirements:

- At a minimum, the exterior doors must have a Sound Transmission Class (STC) rating, conforming to the latest, governing building code.
- All exterior doors must be equipped with adequate security locks including at least one deadbolt per door. Every exterior door, when closed, must fit well within its frame.
- Every front entry door must have a peephole, door knocker or doorbell.
- Every front and rear entry door, door hinge, and door latch and/or lock, must be in good working condition.
- All installed doors must not move to either the opened or closed "ghost" position on their own without an applied force.
- Every interior door with direct access to a garage must have a fire rating of 20 min. with self-closing hinge at the top and bottom.

Each interior door must be at least 2'8" wide, unless otherwise noted, or if the door provides access to a closet of less than 15 square feet. Interior doors must be six panel hollow core doors. Other doors for pantry and small closets must be a minimum of 24 inches wide.

- Every interior door, when closed, must fit well within its frame.
- Every interior door, door hinge, and door latch and/or lock must be in good working condition.
- Every water heater closet and furnace door must be pre-hung with integrated threshold and self-closing hinges at the top and bottom.

Every habitable room must have two independent and unobstructed means of egress. This is normally achieved through an entrance door and an egress window.

In the case of a home identified as an ADA accessible home all doors (front entry, rear entry, and interior doors) must be 3'0" wide unless noted otherwise.

All above grade egress windows from habitable rooms must have a net clear opening of 5.7 sq. ft. The minimum net clear opening width dimension must not be less than 20 inches wide, and the minimum net clear opening height dimension must not be less than 24 inches wide.

Note: *The combination of minimum window width and minimum window height opening size does not meet the 5.7 sq. ft. requirements.*

Only on the second floor, where windows are provided as a means of escape or rescue, they must have a finished sill height of not more than 44 inches above the floor and equipped with child proof window guards. Emergency escape and rescue windows with bars, grills, covers or screens, must be releasable or removable from the inside without the use of a key, tool, or force greater than normal operation of the escape and rescue opening. Any impediment to escape or rescue caused by security devices, inadequate openable window size or difficult operating mechanisms must not be permitted. Occupants of a bedroom must be able to get outside the unit in the event of fire or other emergency requiring quick egress.

E. Stairs, Hallways, Handrails, Guardrails and Ramps

Stairs, hallways, handrails, guardrails and ramps, at a minimum, must conform to the requirement of the UFAS, and any additional standards required by the City. All newly constructed stairs, interior and exterior stairways, at a minimum, must comply with the following requirements:

- All stairways and steps of two or more risers must have at least one handrail.
- All stairways and steps which are 5 ft. or more in width must have a handrail on each side.
- All stairs and steps must have a riser height of not more than 7.75 inches and a tread depth of not less than 10 inches. Risers and treads cannot be different in size by more than 3/8 of an inch from the top to the bottom of the stairs.
- All handrails must be installed not less than 34 inches (2'10") not more than 38 inches in height, measured plumb, above the nosing of the stair treads. Handrails adjacent to a wall must have a space of not less than 1 ½ inches between the wall and the handrail. All handrails must be turned back into the wall on railing ends. The size of a round railing must be a minimum of 1.25 inches, but not more than 2 inches. Railings must be continuous from the top riser to the bottom riser.
- Porches, balconies or raised floor surfaces, including stairway riser and/or landing, located more than 30 inches above the floor or the grade, must have guardrails installed that are not less than 36 inches in height. Open guardrails and stair railings must have intermediate rails or ornamental pattern such that a sphere 4 inches in diameter cannot pass through.
- Only pressure treated lumber must be used for stair/ramp construction and must meet or exceed the requirements of the Prescriptive Residential Wood Deck Construction Guide (see APPENDIX A: Prescriptive Residential Wood Deck Construction Guide), based on the latest adopted International Residential Code by the City of Houston.
- Exposed bent nails in stair/ramp construction, must not be acceptable.

- Individual stair treads must be designed for the uniformly distributed load or a 300- pound concentrate load acting over an area of 4 sq. inches, whichever produces the greater stresses.
- All stairways and hallways must have a minimum width of 3’4”, or 40” measured from face of sheetrock to face of sheetrock.

F. Walkways, Driveways, and Entry

All walkways and entry points to the home must be a minimum of 36 inches wide with an access point from the driveway to the home entrance and/or an access point to the road.

The driveways must be of reinforced concrete of not less than 2500 pounds per square inch (psi) or, based on prospective homebuyer or homeowner selection and available funding, other all-weather surface, i.e., decomposed granite, shells, crushed limestone, etc. These materials form a hard packed surface for an automobile to drive on. These driveways may be used as access for a vehicle to travel from the road to a concrete parking pad or a suitably sized concrete exit pad that will allow a disabled person to exit and enter their vehicle. The exit pad must be a minimum of 36-inch-wide route that meets UFAS standards for slope and lead to 36-inch-wide entry door on the home. The driveway size must be adequate for two vehicles to be parked with a minimum size of 420 sq. ft. not to include apron or public right of way area.

For driveways that cross over ditches and have culverts, the contractor must provide and install culvert headwalls that run from the highpoint of the ditch to the other ditch highpoint. The height of the headwall must extend 8” above the finished driveway surface (see Appendix B: Drainage Exit Structure Headwall).

G. Smoke Detectors

Smoke detectors are required in accordance with National Fire Protection Association (NFPA)¹² 74. All smoke detectors must be hardwired and must have 10-year battery back-up. All Smoke Detectors must be installed in compliance with City of Houston Code requirements in each bedroom.

H. Carbon Monoxide Detectors

Where Carbon Monoxide Detectors are required by code, they must be hard-wired with 10-year battery back-up, installed per the manufacturer’s instructions, typically one per hallway.

Minimum Standards for Ventilation

- A. In general, sufficient ventilation must be present to ensure adequate air circulation in the home per ASHRAE 62.2 and the most current City of Houston adopted mechanical code at the time of permitting and/or City of Houston plan review.

¹² [NASD - Residential Fire Detection \(nasdonline.org\)](http://nasdonline.org)

- B. Every habitable room must have at least one exterior operable window. All operable windows must be capable of being easily opened and held in an open position by window hardware.
- C. Bathrooms, including toilet rooms, must be provided with a mechanical means of ventilation or a window to serve as ventilation. If a continuous exhaust fan is installed, it must be rated at 20 cubic feet per minute (cfm) or greater and if an intermittent exhaust fan is installed, it must be rated at 80 cfm or greater. All bathroom fans must be Energy Star rated and must be installed on a separate switch from the primary light.
- D. Utility room or laundry room exhaust fans must be Energy Star rated. If a continuous fan is installed, it must be greater than or equal to 5 cfm. Intermittent fans must be greater than or equal to 80 cfm.

All exhaust fans must exhaust to the exterior of the house, be mechanically fastened, sealed with duct mastic, insulated, and have a mechanical damper.

E. Attic Ventilation

- When using roof vents without soffit vents and without a ceiling vapor barrier, sufficient vents must be used to provide 1 sq. ft. of free vent area for each 150 sq. ft. of ceiling area.
- When using roof vents without soffit vents with a ceiling vapor barrier, sufficient vents must be used to provide 1 sq. ft. of free vent area for each 300 sq. ft. of ceiling area.
- When using a combination of roof and soffit vents and no ceiling vapor barrier, sufficient vents must be used to provide 1 sq. ft. of free vent area for each 300 sq. ft. of ceiling area. Vents must be installed with no less than 50%, and no more than 80% of the total vent area in the roof near the peak with the balance of vents in the soffit.
- To conserve energy, power roof ventilation systems will be used only as a method of last resort. Roof ventilation should be accomplished through correctly sized gable vents, ridge vents, and soffit vents.

Minimum Standards for Electrical Service

A. Minimum Electrical Service

- All electrical work must be performed by a licensed electrician, and must comply with local, county, or state requirements having jurisdiction. The panel, service mast, etc. must be installed to local utility company requirements. Each home, at a minimum, must have a 200 ampere Arc-Fault panel with a main breaker and 30 available single-pole circuits.
- Service must be of a three -wire type, with service entry on an approved weather head.
- The service meter and service panel must be located above the Base Flood Elevation (BFE) with adequate freeboard required by the City¹³. As per Texas

¹³ https://library.municode.com/tx/houston/codes/code_of_ordinances?nodeId=COOR_CH19FL_ARTIIIISTFLHARE_DIV2STHOSPFLHAAR_S19-33BAFLELREHOSPFLHAAR

Government Code §2306.514 Breaker panel is not to exceed 48 inches above the floor.

- All exposed wiring, service lines and feeders, must be protected and properly shielded in approved conduit.

B. Receptacles

Every habitable room within the home must contain receptacles required by code but not less than the following:

- At a minimum, 2 separate duplex wall mounted type electric outlets. Placement of such outlets must be on separate walls.
- Habitable rooms over 120 square feet, must contain, at a minimum, 3 separate duplex and remote wall type electric outlets.
- All newly installed outlets must be grounded duplex receptacles or Ground-Fault Circuit Interrupter (GFCI) protected.
- Circuit breakers must be Arc Fault type.
- Temporary wiring, extension or zip cords must not be used as permanent wiring.
- The minimum wiring gauge must be 14 Romex on 15-amp circuits with increased wire size as per code.
- As per Texas Government Code §2306.514, duplex outlets must be installed at least 16 inches from the floor. At the prospective homebuyer's or homeowner's request, measure and if approved by the code enforcement department, electrical outlets may be placed between 24 to 30 inches from the floor surface.

A GFCI must be installed for all electrical outlets used in bathrooms and toilet rooms, all outlets within 6 feet of a water source, excluding designated simplex equipment circuits for clothes washing machines and sump pumps, and outlets located on open porches or breezeways, exterior outlets, outlets located in garages and in non-habitable basements, except those electrical outlets that are dedicated appliance outlets. All kitchen receptacles serving the countertop area must be GFCI protected. All exterior receptacles must be covered by a receptacle cover so that when a cord is plugged in, the GFCI outlet will stay covered and protected.

All fixtures and wiring must be adequately installed to ensure safety from fire so far as visible components are observed.

All wall and/or ceiling type lighting fixtures must be controlled by a wall switch.

Each receptacle or switch located on an exterior wall must have a foam seal placed under the cover and must be of the type approved for exterior use.

All outlets and fixtures must be properly installed and connected to the source of electric power in a proper manner and must be in accordance with the electrical code of the city and/or the National Electric Code (NEC), as applicable.

All work must be permitted, inspected, and approved by a City of Houston Enforcement or TREC Inspectors as required by grantor requirements.

All broken and/or missing switch plates and/or receptacle plates must be replaced.
Install TV J-box with conduit to attic in one location.

Unless noted otherwise, the contractor must provide and install pre-wire for cable and Category-5 outlets (computer network cables, also may be referred to as ethernet cables).

Unless noted otherwise, the contractor must provide and install pre-wire for an alarm system.

Provide exterior WP (weatherproof) electrical convenience outlets installed in accordance with local building codes and National Electrical Code (NEC) requirements. Provide two exterior outlets, one in front and one in back.

Hazardous and Substandard Conditions

These conditions must include but are not limited to:

- Equipment or wiring which is missing, broken, disconnected, loosely connected, burnt, unsupported, corroded, cracked, split, has evidence of overheating, physical damage, or misuse.
- Device or equipment is dirty, full of debris, infested, etc.
- Frayed wiring is present.
- Circuit breaker, switch, receptacle, fixed equipment, wiring, or cable is not compatible with the phase, voltage, amperage, or other characteristics of the electricity in use.
- Intermittent operation of fixed equipment, switches, outlets, or other devices.
- Flexible cord is used as a permanent wiring method.
- Interior wiring is surface mounted and not conduit. This excludes crawl spaces and other allowable installations where access to wiring is limited.
- Exterior wiring which is exposed to damp conditions, sunlight, or potential damage that is not in conduit.
- Bathroom receptacle, kitchen receptacle located within 6 feet of water source, garage receptacle, or other outdoor receptacle that is not protected by a ground fault interrupting device.
- Polarity is reversed in connections or receptacles.
- Branch circuits, feeder lines, cable size, device rating, circuit breakers, sub-panels, or service panels are inadequate for the load as calculated by the current NEC standard Section 110-14.
- Unlabeled circuit breakers.
- Overhead wires from the street to the electrical service panel must be no lower than 12 feet above ground and must not come in contact with tree branches or other obstacles and must not be reachable from nearby windows or other accessible areas.

C. Lighting

- Every habitable room and every bathroom, including toilet room, laundry room, furnace or utility room, and hallway must have at least one ceiling or wall-type electric light fixture, controlled by a wall switch.
- At least one light must be installed at each exterior door operated by an interior switch that is within reach of the door.
- Provide one porcelain receptacle light fixture in attic switched at attic entrance.
- Habitable rooms, except kitchens, must have 2 working duplex receptacles or a single wall-type electrical outlet and a permanently installed lighting source.
- Energy efficient fixtures that meet Energy Star ratings must be used. Light-Emitting Diode (LED) lighting must be installed in all new homes.
- All closet lights must be covered with no exposed bulbs.
- **Hazardous and Substandard Conditions**
These conditions typically identified in the departments rehab or Tier II program must include but not limited to:
 - Missing or dysfunctional overhead or other switch operated lighting in each interior room.
 - Missing or dysfunctional lighting at each exterior door operated by an interior switch that is within reach of the door.

D. Energy Star rated ceiling fans must be installed in general living areas, living room and all bedrooms, and must be installed to manufacturer's requirements.

E. All ceiling fans must have light kits and acceptable manufacturers must be Hunter, or an approved equal product.

Minimum Standards for Heating Systems

A. Heating and Cooling System

All heating and cooling systems must be capable of safely and adequately heating and cooling all living space. The capacity of the systems must be sized in accordance with all local, state and grantor codes, ordinance and requirement.

B. Requirements for Heating and/or Cooling Systems

- Every heating system burning liquid or gaseous fuels must be vented in a safe manner to a chimney or flue leading to the exterior of the home. The heating system chimney and/or flue must be of such design to assure proper draft and must be adequately supported.
- No heating system source burning liquid or gaseous fuels must be located in any habitable room, bathroom, toilet room, storage closet, and sealed attic space unless it is a sealed combustion system, approved by HCDD.
- Every fuel burning appliance, liquid, or gaseous fuels, must have adequate combustion air and ventilation air. All liquid furnaces will have sealed combustion with combustion air brought in from the exterior of the house and installed in

accordance with manufacturer's guidelines. Combustion air for gas furnaces must be in accordance with 2015 or the latest IRC adopted by the City of Houston.

- Every heat duct, steam pipe and hot water pipe, must be free of leaks and must function such that an adequate amount of heat is delivered where intended. All duct joints must be sealed with mastic or any other acceptable product. All ducts must be sealed. All steam piping and hot water piping must be installed with an approved material.
- Every seal between any of the sections of the heating source(s) must be air-tight so that noxious gases and fumes will not escape into the home.
- Minimum requirements for forced air furnaces, when installed, will be no less than a 92% Annual Fuel Utilization Efficiency (AFUE). Also, a digital programmable thermostat must be installed. Condensate lines will drain to a floor drain or have a condensate pump installed and piped to discharge. All furnace ducts must be equipped with an air filter clean out location that has a tight-fitting cover installed over it.
- Central heat/air conditioning (A/C) units must be gas or electric systems and the air conditioning unit must be at a minimum of 16 SEER rating. All units must be installed, when feasible, on either the north or east side of the home or in an area that will provide shade for the unit. **Note:** *Acceptable package units must be Trane Lennox, Carrier, or approved equal.*
- Venting and combustion air must be installed in accordance with manufacturer's requirements.
- All air conditioning packages must include a 4" thick concrete pad for the proposed condensing unit with a lockable air conditioning security cage.

Energy Conservation

- A. All newly constructed structures, at a minimum, must comply with the Environmental Protection Agency (EPA) and the current (International Energy Conservation Code) IECC for Energy Star New Home Requirements¹⁴.
- B. All rehabilitated homes to the maximum extent feasible must be compliant with the HUD CPD Green building Retrofit Checklist¹⁵.
- C. Under the DR-21 program (URI), all rehabilitated homes to the maximum extent feasible must be compliant with the Zero Energy Ready Homes Guidelines. These measures include, but are not limited to, the following:
 - The provision of insulation at various locations and at the following recommended resistance factors (R-values). Insulation must be primarily made from fiber glass when available.
 - Ceilings – R-38 or as close as possible to these requirements where sloped ceilings exist.
 - Attic space – R-38 blown in or spray foam.
 - Walls - R-15 batt insulation
 - Crawl Spaces (floors) – R-19 (closed cell foam insulation)

¹⁴ http://www.energystar.gov/index.cfm?c=bldrs_lenders_raters.nh_v3_guidelines

¹⁵ <https://www.hud.gov/sites/dfiles/CPD/documents/CPD-Green-Building-Retrofit-Checklist.pdf>

- Floor Joists – R-19 (closed cell foam insulation)
- Closed cell Foam to meet R Value or Noise Values as required by the adopted local code and HCDD Environmental Review Procedures #21-016.
- Exterior walls are to be provided with insulation and the minimum R-factor must be R-15. In addition, an air infiltration barrier, such as Tyvek or approved equal, must be installed on all exterior walls. The installation of fan-fold foam or foam sheathing may be added to increase household R-ratings.
- When siding is being placed on exterior walls, such exterior walls are to be provided with insulation and at the recommended resistance factor (R-value) of R-15. In addition, an air infiltration barrier, such as Tyvek or approved equal, must be installed on all exterior walls.
- The installation of fan-fold foam or foam sheathing may be added to increase household R-ratings.
- The installation of weather stripping at all exterior doors, windows, attic access, etc. is required. Exterior doors must be metal clad insulated doors and Energy Star rated for Climate Zone 2. Door jams must be sealed, and thresholds must be caulked.
- The provision of caulking around exterior doors, windows, and at the foundation sill plate union, and at any other air infiltration areas.
- All windows must be Energy Star certified. All windows are single-hung or fixed, double pane, low-E, argon, or krypton filled, insulated, white vinyl or equal. All windows must have a U-Value of less than or equal to 0.35 and Solar Heat Gain Coefficient (SHGC) of less than or equal to 0.25. All windows must receive window screens and all bathroom and kitchen windows and windows within 2 feet of any door, must be tempered.
- At a minimum, windows must be current Energy Star rated for Climate Zone 2. All windows must have the window jamb sealed. Where Historic Preservation requirements will restrict the installation of vinyl or aluminum windows, the standards are written to come as close as possible to achieving Energy Star requirements.
- The contractor must provide and install 2" black or white venetian blinds on all windows.
- All heat ducts and hot water or steam heat distribution piping must be insulated or otherwise protected from heat loss where such ducts or piping runs are located in unheated spaces. Similarly, distribution piping for general use of hot water must also be protected from heat loss where such piping is located in unheated spaces. All water distribution piping must be protected from freezing. All ducts and piping must be free of leaks.
- If there are no appliances in the attic scuttle hole will be allowed. All homes must have pull downstairs with a weight rating of 300 lbs. where there will be appliances in the attic.
- Attic stair units must be an insulated manufactures design with weather stripping around the perimeter.

D. Hazardous and Substandard Conditions

These conditions must include, but not limited to:

- Air incursion from open holes or seams in exterior walls, windows, or doors.
- Open seams in window casements, door casements or other installations that create air leaks resulting in heat loss or gain.
- Missing caulk or putty in windows.
- Missing weather stripping or other seal at exterior doors.
- Exposed plumbing systems that present freeze hazards or heat loss to hot water pipes.
- Inadequate insulation in ceiling.

Minimum Standards for the Interiors of Structures

A. Floors, Walls, Ceilings, Doors and Windows

- All subfloors on elevated homes must be 1 1/8" tongue and groove solid and continuous plywood, without liberal movement or bounce, free from rot and deterioration and free from defects.
 - OSB subflooring is not acceptable for use.

Note: *Acceptable products must be Advantech, Plytanium STURD-I-FLOOR, or approved equal.*

- All flooring must be free from trip hazards with a minimum of seams spaced at logical locations such as doorways and matched to the existing floor.
- All vinyl plank finished flooring must be 1/8" thick and glued down over a self-leveling float over a fluid applied vapor barrier.
- Floor finishes must be slip resistant when wet. Any flooring material that permits water to seep into the sub flooring over 1/8" thick underlayment floor is unacceptable. Provide vinyl plank flooring, minimum 0.12 inches thick in living, dining, kitchen, bathrooms, and utility rooms.
- Carpets must be free from all defects such as tainting, bare patches, and so on. At a minimum, provide carpet of 25 ounce/square yard with a carpet pad with 6 lb. density.
- Interior wall surfaces must be free from chipped, cracking, or peeling paint. All such loose paint must be completely removed, and bare wood surfaces primed. All primed surfaces must be properly painted with a 2-coat minimum.
- Interior walls must be smooth or textured and must comply with UPCS.
- Provide minimum 4-inch interior walls and 6-inch plumbing walls.
- Rounded sheetrock edges must be provided as a standard option; however, at the request of the prospective homebuyer or homeowner, straight edges may be provided at no additional cost to the City or the homeowner.
- Provide minimum 2 and 1/4-inch paint grade solid casing around doors and windows, unless noted otherwise.

- Every bathroom and/or toilet room, kitchen, and utility room floor surface must be constructed such that they are impervious to water and can easily be kept in a clean and sanitary condition by the owner.
- Provide washer/dryer hookups.
- All interior doors must have raised panels, which must be capable of affording the privacy for which they are intended.
- All bedrooms must be a minimum of 121 square feet plus a closet. The minimum furniture wall in master bedroom must be 12 feet and minimum diagonal measurement of bedroom room must be 11 feet. A minimum of 5 feet wide by 2 feet deep closet required in each bedroom and maximum of 18 square feet. Walk-in closet in master bedroom must be minimum of 25 square feet.
- All paint, stains, varnishes, lacquers, and other finishes must be durable with low levels of Volatile Organic Compounds (VOCs) paint finishes and installed as required by the manufacturer. Minimum standards must include a satin or flat paint finish on all walls and ceilings but must be consistent throughout the home. Provide semi-gloss or gloss paint on all trim and woodwork.

Note: Acceptable manufacturers must include Sherwin Williams A100 standard or equivalent. Any substitutions must be approved by the HCDD construction team prior to application.

- All windows must meet or exceed the minimum requirements for Sound Transmission Class (or STE) ratings as required by location.
- All windows must have a U-value of less than or equal to 0.35 and an SHGC of less than or equal to 0.25 and meet energy star 3.0 requirements and flashed with butyl tape.
- All bedroom escape windows must meet or exceed the most current City of Houston adopted code and all windows must have tempered glass at all kitchens, bathrooms and adjacent exit, and closet doors within the code required distance.

B. Hazardous and Substandard Conditions

These conditions must include, but are not limited to:

- Damaged, rotted, or deteriorated subfloor surfaces.
- Torn, missing, worn, burned, or otherwise damaged floor coverings that create a tripping hazard or unsanitary condition.
- Missing baseboard, shoe mold, or sealant that creates an unsanitary condition.
- Sealed or blocked windows including windows which have been painted shut, windows which are not operational, or windows which will not function as a variable fire exit such as windows with burglar bars which cannot be opened readily from the inside.
- Windows that do not lock or locks that do not function with ease.
- Any exterior door which is not insulated, sealed, or painted, and which does not have a functioning lockable deadbolt.

Minimum Standards for Exterior of Structures (General Framing)

A. Texas Government Code Section 2306.514. Construction Requirements for Single Family Affordable Housing

§ 2306.514. CONSTRUCTION REQUIREMENTS FOR SINGLE FAMILY AFFORDABLE HOUSING – In the event of a conflict of between TGC 2306.514 and other programmatic guidance, the more stringent requirements must apply.

(a) If a person is awarded state or federal funds by the State of Texas to construct single family affordable housing for individuals and families of low and very low income, the affordable housing identified on the person's funding application must be constructed so that:

(1) at least one entrance door, whether located at the front, side, or back of the building:

(A) is on an accessible route served by a ramp or no-step entrance; and

(B) all means of ingress/egress area minimum of 36-inch in width.

(2) on the first floor of the building:

(A) each pass-through interior door is at least 32 inches wide unless the door provides access only to a closet of less than 15 square feet in area.

(B) each hallway has a width of at least 40 inches and is level, with ramped or beveled changes at each door threshold.

(C) each bathroom wall is reinforced for potential installation of grab bars.

(D) each electrical panel or breaker box, light switch, or thermostat is not higher than 48 inches above the floor.

(E) each electrical plug or other receptacle is at least 16 inches above the floor; and

(3) each breaker box is located inside the building on the first floor.

Added by Acts 1999, 76th Leg., Ch. 1581, § 1, eff. Sept. 1, 1999.

Last modified: August 10, 2007

B. Foundations, Exterior Walls, Roofs, Soffits and Fascia

- Every foundation, exterior wall, roof, soffit, and fascia must be made weather resistant.
- Products for exterior walls, roofs, soffits, and fascia must be installed in accordance with the manufacturer's guidelines.
- For pier and beam foundations elevated between 0 feet to 3 feet above grade, skirting must be installed with a hinged access door and the proper venting.
- For pier and beam foundations elevated between 0 feet to 3 feet above grade, where required insulation is installed, the contractor must provide and install treated plywood, Hardie plank or an approved equal product, approved by HCDD, as an underpin, caulked at the perimeters, to keep insulation in place, to provide moisture protection, and to provide insect and rodent protection.

- For pier and beam foundations elevated between 0 feet to 3 feet above grade, termite shields must be installed at all piers and grade beams, if applicable.
- All building foundation type and other supporting structures must be designed and sealed by a licensed Professional Engineer (PE) registered in the State of Texas.
- All foundation types must be designed in accordance with the latest International Residential Code adopted by the City of Houston and in accordance with City of Houston building codes and requirements.
- All new construction must meet or exceed Windstorm requirements per City of Houston new construction standards or the latest IRC adopted by the City of Houston.
- Concrete must be a minimum of 2500 Pounds per Square Inch (PSI) with a 28-day cure. During this period of curing, framing will be allowed to occur.
- For rehabilitation work and If applicable to the scope of work, foundation leveling must be done in such a manner as to be permanent and must be completed before other work begins. Prior to the work performed, a signed and sealed structural engineer's report on the condition of the foundation must be required to submit to HCDD and at the completion of the work.
- Only pressure treated lumber may be used for pier and beam foundations.
- If the City of Houston's environmental Tier II site-specific review indicates noise attenuation is required, the dwelling must meet the federal requirement not to exceed more than 45 decibels (dB) for interior sound. There must be a Noise Certification or Sound Testing performed if noise attenuation is required.
- The roofing must be installed in accordance with the manufacturer's requirements. Provide and install 30-year architectural shingles over 30 lbs. felt or a generic synthetic felt, or equivalent product.

Note: *Acceptable products may include Owens Corning ProArmour, Sharkskin Roof underlayment or approved equal.*

- All new roof decking must be 5/8" CDX/ APA rated plywood sheathing and all joints must be taped with Roof Deck Seam Tape or approved equal.
- All replaced decking must be of a type that is compatible with the existing decking, thus making the roof subsurface smooth and free from defects. Oriented Strand Board (OSB) decking will not be acceptable.
- All wall studs, ceiling joist, and rafters must be #2 Southern Yellow Pine and as called for by the structural engineer of record. No finger joint material will be allowed. Stud walls and rafters must be a maximum of 16 inches "on-center".
- All exterior sheathing must be 7/16 OSB applied with recommended engineered nailing pattern.
- All roof jacks must be lead and painted to match the roof shingles.
- Under the DR-21 (Winter storm Program), all new construction must be equipped with Tesla Solar Panels or an approved equal product on a newly constructed roof system.
- Under the DR-21 (Winter storm Program), all new construction must be equipped with a natural gas Generac generator or approved equal product.

- All exterior walls must be a minimum of 4 inches thick unless otherwise noted.
- Cement board sidings on homes elevated above 3.0 feet, exterior walls must have ½-inch plywood or OSB using 6d galvanized nails or better.

C. Landscaping, Lawn Areas, and Trees

- Lawn must be consistent with comparable units and sodded with St. Augustine sod (grass) as described below.
 - All areas around the housing structure must have sod at least 20 feet from slab to the left and right, or to side property lines, and rear of house. The front yard of the house must have full sod.
 - Sod (grass) must be installed as necessary to establish consistency with comparable units and properly rolled to eliminate uneven and rutted surfaces.
 - All concrete remnants and construction debris must be removed.
 - The lawn must be appropriately mowed and trimmed at the time of inspection in rehab, reconstruction, and new construction.
 - Provide and Install Trees
 - Provide a minimum of 2 trees with a caliper of 2 inches from the approved City of Houston tree and shrub list.
 - Provide a minimum of 10 shrubs from the approved City of Houston tree and shrub list.
 - A minimum of one tree will be required in the front yard of each single family unit and be properly located on the site.
 - The new trees required must be 25-gallon size trees or larger and must be appropriately planted and watered to ensure sustainability.
 - Existing trees too close to the structure or threatening the structure must be trimmed or must be removed.
 - Generally, trees that require trimming must have the branches cut back to the main trunk.
 - Existing trees that could damage an adjacent structure above or below the foundation must be removed.
 - Existing trees that present a safety hazard because electrical wiring runs through them must be trimmed or the trees must be removed.
 - The final grade must have proper slopes away from house with a minimum 6" slab exposure and must be level with all flat work at a minimum.
 - Grading below elevated structure must provide positive drainage away from house footprint and prevent pooling under the house.
 - Unless noted otherwise, or as required by the Request for Proposal (RFP), the contractor must provide and install a new treated wood, perimeter

fence as prescribed in the HCDD TYPICAL FENCE CONSTRUCTION DETAIL (DIAGRAM 2023-01A) (See Appendix C: Wood Fence Detail).

- Contractors must provide irrigation and care of sod and trees until transfer of custody of home to homeowners is complete.
- **Hazardous and Substandard Conditions**
 - These conditions must include but are not limited to:
 - Water draining and/or pooling under foundation area.
 - Ground contact of untreated wooden structure; or
 - Several slab cracks that create or threaten structural or other systems such as plumbing.

D. Drainage

- All rainwater must be conveyed and drained away from every roof so as not to cause wetness or dampness in the structure. No roof drainage systems must be connected to a sanitary sewer.
- Finished Grade at house foundation must provide positive drainage away from structure and must start a minimum of 6 inches below finish floor at slab on grade or a minimum of 6 inches below pier structure for elevated floor.
- The property must not have any standing water that causes a public health hazard. Run-off must not encroach on adjacent property to create a hazard or drainage issue.
- The property must have a minimum drainage to drain water from the foundation of the house per latest International Residential Code as adopted by the City of Houston.

E. Windows, Exterior Doors and Egress

- Every window and exterior door must be tight fitting within their frames, be pest rodent-proof, insect-proof and weatherproof such that water and surface drainage is prevented from entering the dwelling. In addition, the following requirements must also be met:
 - All exterior doors and windows must be equipped with security locks. Doors must be fire rated as required by code.
 - Every window sash must be fully equipped with glass windowpanes which are without cracks or holes, must use Energy Star windows rated for Climate Zone 2, must fit tightly within its frame, and be secured in a manner consistent with the window design. All window jambs will be sealed, and Energy Star rated for Climate Zone 2.
 - Storm doors must also be equipped with a self-closing device.
 - Every exterior door, when closed, must fit properly within its frame, and must have door hinges and security locks or latches. All exterior doors will be no less than metal clad insulated, foam or fiber filled doors. All jambs must be painted and sealed. Thresholds will be zero step entry clearance and sealed.
 - Window sizes in living and master bedrooms must have a minimum glazing of 30 sq. ft and maximum of 45 sq. ft. Dining rooms and bedroom windows must have

- o a maximum glazing of 30 sq. ft, kitchen windows must have a maximum glazing of 15 sq. ft, and bathroom windows must have a maximum glazing of 9 sq. ft.
- o The total window area that can be opened in every habitable room must be equal to at least 50 percent of the minimum window area size.

Mailbox & House Numbers

- Every dwelling unit must have a mailbox which meets United States Postal Service (USPS) standards. Mailboxes must be accessible to the mail carrier, convenient to inhabitants, & handicapped accessible.
- Where applicable, for every house that is proposed to be replaced that has an existing curb-side mailbox, that mailbox must be preserved or replaced in the same location. The contractor must coordinate with the DHCDD Field Inspector and the Homeowner at the time of the NTP/Demolition.
- Address numbers must have a minimum 3" height and visible from the street for all first responders and all City and Independent agencies.

Minimum Standards for Plumbing Systems

- A. All plumbing systems must be capable of safely and adequately providing a water supply and wastewater disposal for all plumbing fixtures. Each plumbing system must comply with the following requirements.
 - All plumbing systems and plumbing system components must be free of leaks. Any type of pipe allowed by the plumbing code must be allowed in accordance with any local, county or state requirements having jurisdiction.
 - All plumbing system piping must be of adequate size to deliver water to plumbing fixtures and to convey wastewater from plumbing fixtures, including proper slope of wastewater piping as designed by the fixture manufacturer. All piping materials must be in accordance with the City's specifications.
 - All plumbing fixtures must be approved by the prospective homebuyer or homeowner, in good condition, free of cracks and defects, and capable of being used for the purpose in which they were intended.
 - The plumbing system must be vented in a manner that allows the wastewater system to function at atmospheric pressure and prevents the siphoning of water from fixtures. Venting by mechanical vents is accepted as an alternative to exterior atmospheric venting.
 - All fixtures that discharge wastewater must contain, or be discharged through, a trap that prevents the entry of sewer gas into the dwelling.
 - All plumbing system, piping and fixtures, must be installed in a manner that prevents the system or any component of the system from freezing.
 - All plumbing fixtures and water connections must be installed in such a way as to prevent the backflow of water from the system into the plumbing system's water source.

- All faucets must have aerators that restrict water flow to less than 2 gallons per minute (gpm). Provide toilets that only use a maximum of 1.28 gallons per flush (gpf). Faucets must be free from leaks or drips and must shut-off completely.
- Valves must be installed with the valve in the upright position and full port ball-valve must be used.

Minimum Standards for Potable Water Supply

- A. Every dwelling must be connected to an approved, by the jurisdiction having authority, potable water source.
- B. All potable water fixtures and equipment must be installed in such a manner as to make it impossible for used, unclean, polluted, contaminated water, mixtures, or substances to enter any portion of the potable water system piping. All equipment and fixtures must be installed with air gaps (traps) to prevent back siphonage. All outlets with hose threads, except those serving clothes washing machine, must have a vacuum breaker for use with the application. No water piping supplied by a private water supply system must be connected to any other source of water supply without the approval of the jurisdiction having authority over the installation.
- C. The following shut-off valves will be installed:
 - One owner's shut-off at the meter or supply source;
 - One shut-off at each toilet;
 - One shut-off each for hot and cold water at each sink/lavatory;
 - One supply side shut-off at each water heater; and
 - At least two exterior faucets must be installed, and all faucets must be freeze protected or insulated to a minimum R- value of 3.5.
- D. All unused wells on the property must be abandoned and plugged-in accordance with any city or state requirements having jurisdiction. All cisterns must be drained and filled, and if applicable, in accordance with any city or state requirements having jurisdiction.
- E. **Hazardous and Substandard Conditions**
 These conditions must include but not limited to:
 - Lack of continuous sanitary water supply, where ground wells are used, this source must be approved for drinking, or a secondary source of drinking water must be available.
 - Deteriorated, corroded, broken, or otherwise worn water supply.
 - Evidence of leaks, either continuous or intermittent, of water supply lines.
 - Missing or dysfunctional shut-off valves.
 - Lack of fully functioning faucets at each sink/lavatory, bathtub/shower, and at least two exterior hose bibs.

Minimum Standards for Connection to Sanitary Sewer

A. Every dwelling must be connected to an approved, by the jurisdiction having authority, sanitary sewer system or properly operating septic system.

B. Hazardous and Substandard Conditions.

These conditions must include but are not limited to:

- Lack of continuously functioning sanitary wastewater disposal system.
- Missing, dysfunctional, or nonexistent sanitary facilities including a functioning toilet in a separate room designed for such purposes.
- The lack of at least one sink and or lavatory for hygiene and at least one sink for kitchen purposes each providing a continuous flow of both hot and cold water.
- The lack of at least one functional bathing facility.
- Evidence of leaks, either continuous or intermittent, of wastewater supply lines.
- Missing or blocked vent pipes or sewer odors.

Minimum Resiliency Measures

At a minimum, the following resiliency measures must be incorporated:

- A.** Elevate the structures above the floodplain in accordance with the City of Houston ordinances or the requirements set forth by HUD or the GLO, whichever is most restrictive. This measure takes the entire structure out of the hazard zone, thus minimizing or eliminating future flood risk for these homes. All reconstruction and new construction homes on this program will be built to meet the City’s Chapter 19 Ordinance requiring 2 feet of freeboard above the 500-year flood event Elevation. Rehabilitated homes that are substantially damaged or substantially improved will be elevated, where feasible and practical, to meet this elevation requirement as well.
- B.** Where feasible and requested by the homeowner, ground level mechanicals such as HVAC Condenser Units, Water Heaters, and Furnaces 2 feet above the 500-year flood event height, per flood certificate, to protect them from future flooding and will minimize remedial costs from future events. These mechanicals are often the most expensive non-structural components of the home, so it is prudent to address them, where feasible, as a resiliency measure.
- C.** During the course of Initial Site Inspections (ISI), the inspector will examine the site for apparent drainage issues and question the homeowner to document any reported site drainage issues. These issues can be addressed as part of the scope of work.

Minimum Hazard Protocols

A. Mold

For program homes that will receive rehabilitation, HCDD will test for mold under the following circumstances:

- Initial on-site interview with the homeowner indicates a known or suspected mold presence in the home.
- The visual presence of mold is noted during the initial home inspection.
- Mold odor is detected during the initial home inspection.
- Upon completion of the mold or asbestos investigation, a report will be provided an inspection report.

a. Mold Testing

The City reserves the right to require the contractor to provide necessary inspections and clearances from a certified Mold Assessor for mold hazard remediation. The Mold Assessor will conduct air sampling inside and outside the home to assess the level of mold spores. This testing is non-destructive and typically completed in one to two hours. Moisture testing may also be required in some circumstances and this testing is also non-destructive. Samples collected are sent to an approved laboratory for analysis, then the Mold Assessor produces a Mold Assessment Report.

b. Mold Remediation (if required)

If mold impact is found in the home, HCDD will add mold remediation to the rehabilitation scope of work. The assigned builder will engage a Texas-licensed mold professional to address the mold during the course of the construction project. The clearance letter and fees are part of the scope of services secured by HCDD unless otherwise noted as the responsibility of the General Contractor.

c. Lead Based Paint

For program homes that will receive rehabilitation, lead based paint attesting will occur under for all homes constructed prior to 1978.

The City reserves the right to require the contractor to provide necessary inspections and clearances from a certified Lead Based Paint (LBP) assessor for lead hazard remediation. Also, the City may require work to be performed by another contractor through its Lead Hazard Reduction Program. An LBP assessor will perform an inspection, risk assessment protocol, and provide clearance.

d. Lead Based Paint Remediation (if required)

The City reserves the right to require the contractor to provide necessary inspections and clearances for a certified Lead Based Paint (LBP) assessor for LBP hazard remediation. If LBP is detected in the home, HCDD will add LBP remediation to the

rehabilitation scope of work. The assigned builder will engage a Texas-licensed LBP abatement professional to address the LBP during the construction project.

e. General Contractors Instructions

Before regular construction can begin, HCDD will notify the General Contractor (GC) of the homeowner moveout date and give the earliest date to start abatement work. The GC and their abatement contractor are to schedule directly with the environmental company whose inspection report is attached to the bid package. All abatement activities and fees are the responsibility of the GC, except the clearance letter, if applicable. The clearance letter and fees are part of the scope of services secured by HCDD unless otherwise noted as the responsibility of the GC.

B. Asbestos-Containing Materials (ACM)

a. ACM Screening

HCDD will utilize GIS mapping to follow National Emission Standards for Hazardous Air Pollutants (NESHAP)¹⁶ to determine if a home is subject to testing for program homes that will receive rehabilitation or re-construction.

b. ACM Testing

The City reserves the right to require the contractor to provide necessary inspections and clearances from a certified ACM assessor for Asbestos hazard remediation. The ACM assessor will perform an inspection, risk assessment protocol, and provide clearance.

c. ACM Remediation (if required)

If ACM is detected in the home, HCDD will add ACM remediation to the rehabilitation scope of work or will include the abatement scope for homes that will be demolished and reconstructed. The assigned builder will engage a Texas-licensed ACM abatement professional to address the ACM during the construction project.

d. General Contractors Instructions

Before regular construction can begin, HCDD will notify the General Contractor (GC) of the homeowner moveout date and give the earliest date to start abatement work. The GC and their abatement contractor must submit the required 10-Day notification to the state and schedule directly with the environmental company whose inspection report was attached to the bid package. **NOTE:** *The GC will be identified as the “Facility Owner” on the 10-Day notification. All abatement activities and fees are the responsibility of the*

¹⁶ <https://www.epa.gov/stationary-sources-air-pollution/national-emission-standards-hazardous-air-pollutants-neshap-8>

GC, including ARU fees, except for the clearance letter. The clearance letter and fees are part of the scope of services secured by HCDD.

Minimum Requirements for Manufactured Housing Units (MHU)

Construction standards for new Manufactured Housing Units (MHUs) are set by the National Manufactured Housing Construction and Safety Standards act of 1974¹⁷, the Texas Manufactured Housing Standards Act (Article 5221F)¹⁸, and HUD Code Standards 3280¹⁹ and 3282²⁰.

During the installation process, the MHU is placed on its installation location as indicated on the site inspection drawing; blocked, leveled, and anchored; utilities connected; and outfitted with proper skirting, stairs, ramps, and landings. The MHU should be made ready for occupancy by testing all appliances. The lot should be cleaned and have all extraneous material removed.

All MHUs are installed to the same standards including all applicable federal, state, and local laws or regulations, as well as the manufacturer's installation instructions. In the case of conflicting requirements, the most stringent, specific, and definitive rule will be followed. Any deviation from the approved site location must be approved in advance by the City of Houston.

A. Site Usage Permits

All permits required to install an MHU must be identified and obtained.

B. Nominal Site Grading

Grading below MHU must provide positive drainage MHU footprint and prevent pooling under the unit. Grading must be consistent with comparable units and must be sodded with St. Augustine sod as described below.

- All areas around the housing structure must have sod at least 20 feet from slab to the left and right, or to side property lines, and rear of house and front yard must have full sod.
- Contractors must provide irrigation and care of sod and trees until transfer of custody of home to prospective homebuyers or homeowners.

C. The property must not have any standing water that causes a public health hazard. Run-off must not encroach on adjacent property to create a hazard or drainage issue.

D. Power, Water, and Sewer Connections

All excavations must be performed in accordance with the local requirements. Utility line installation is measured at the external point of the MHU closest to the utility connection

¹⁷ <https://www.govinfo.gov/link/uscode/42/5401>

¹⁸ <https://www.tdhca.state.tx.us/mh/docs/Law-20010901-20030531.pdf>

¹⁹ <https://www.ecfr.gov/current/title-24/part-3280>

²⁰ <https://www.ecfr.gov/current/title-24/part-3282>

for each utility. All utility service connections must be provided in accordance with the local ordinance requirements and manufacturer specifications.

- E. All MHUs must be installed on a permanent foundation.
- F. All MHUs will be tied down through the installation of approved tie downs adequate to meet federal, state, and local requirements.
- G. All road transport accessories such as wheels, trucks, and hitching devices must be removed to make installation permanent.

H. Power Poles with Meter Loop

Furnish and install power pole and meter loop with appropriately sized service. Install an overhead electric assembly. The assembly must be appropriately sized for the MHU scheduled to be installed with a weatherproof, rain-tight meter box containing the main circuit breaker. All components must be installed in accordance with the NEC and local codes. All conduit connections on the meter pole must be watertight.

I. Power Pedestals

Power pedestals must be provided when required to place a power meter. This requires approval prior to installation from the City of Houston.

J. Install and Test Heating, Ventilation, and Air Conditioning (HVAC)

The HVAC system must be installed in compliance with the manufacturer's specifications. Prior to reporting the unit as ready for occupancy and requesting a City of Houston acceptance inspection, the heat and air conditioning units must be operated for 30 minutes to ensure they are properly functioning as intended. Installation of the HVAC unit must be considered part of the basic unit installation.

- K. If approved by the prospective homebuyer or homeowner, the code enforcement department, and if applicable; Homeowners Association, the HVAC system may be elevated as a resiliency measure.
- L. For pier and beam foundations elevated between 0 feet to 3 feet above grade, skirting must be installed in accordance with appropriate codes and as required by the local and neighborhood regulations. Composite or UV resilient vinyl materials must be used in the construction of all skirting materials.
- M. If skirting is not required by code or neighborhood regulations, skirting is optional at homeowner's discretion.

N. Steps, Platform Stairs, and Ramps

Install steps and a deck/landing at each entrance to the MHU unless the work order directs the installation of platform stairs or ramp. When constructing ramps, the UFAS must apply.

O. Removal of equipment, excess materials and debris

The site must be free of all excess equipment, materials, and debris and the MHU has to be appropriately cleaned prior to declaring the MHU to be ready for occupancy.

P. Treated wood fencing

All perimeter/ privacy fencing, as called for on the construction documents must be constructed of cedar wood. All vertical 4 inch x 4 inch posts must not exceed 6 feet on center (o.c.). There must be a 1 inch by 10 inch cedar rot board, attached to the front of the post with a chamfered edge to prevent ponding. There must be a 2 inch x 4 inch intermediate horizontal board, between posts to act as picket nailer, and there must be a continuous 2 inch x 4 inch top post, also to act as picket nailer. See Appendix C: Wood Fence Detail.

Q. Keys

A minimum of 2 sets of keys must be provided for each MHU.

R. MHUs slated for demolition must be destroyed and disposed of in accordance with applicable standards. Additionally, all household waste must be disposed of in accordance with federal, state, and local environmental regulations.

S. Hazardous and Substandard Conditions

These conditions must include but are not limited to:

- A MHU that is not permanently situated on a permanent foundation.
- A MHU that is not adequately tied down or affixed by an approved tied down system.
- A MHU that has not had its wheels, truck, and hitch removed.

Rights to Alter Design

The City of Houston reserves the right to alter plans to accommodate site specific design or elements to accommodate end user for accessibility or any other requirements.

CHANGE LOG

Version	Date Adopted	Changes
1.0	6/24/2002	Original Version
2.0	4/5/2011	Updated based on current practice
3.0	5/16/2019	Overhauled
4.0	1/18/2022	<p>Added state and local funding; ADA requirements; and General standards to minimum space, use, and location requirements. Revised Exits under Minimum Space Use and Location and Landscaping under Minimum Standards for Exterior Structures. Updated minimum standards for basic equipment and facilities; Minimum standards for electrical service; Energy conservation requirements; and Minimum standards for interior and exterior structures. Added hazard protocols. Deleted examples of counter-top surfaces.</p>
5.0	04/13/2022	<p>Updated to minimum space, use, and location requirements; Minimum standards for interior structures; and Minimum standards for exterior structures. Replaced 2012 IRC requirements with 2015 IRC requirements.</p>
5.1	03/14/2023	<p>Added Appliances must match in color and brand Added Construction Standards for DR-21 funding (Winter Storm Uri), i.e., Zero Energy Ready Home Guidelines, Concrete Samples for Concrete Pours, Solar Panels, Natural generators, etc. Added Construction Standards for HC-3 Bathroom Added Construction Standards for Treated Wood Fencing Updated Definition Section</p>
5.2	07/05/2023	<p>Updated cabinet height requirements for NHDP. Added minimum garage sizes. Added requirement for driveway headwalls over culverts/ditches. Added requirements for blinds on windows.</p>
5.3	03/25/2024	<p>Minimum Space Use & Location Requirements</p> <ul style="list-style-type: none"> Removed length of wall for living room

Version	Date Adopted	Changes
		<ul style="list-style-type: none"> • Added at least one escape room for all bedrooms • Added automatic garage door openers and 2 remotes • Added acceptable automatic garage door brands • Added the width and depth of 1 and 2 car garage • Removed lot dimensions <p>Minimum Standards for Basic Equipment and Facilities</p> <ul style="list-style-type: none"> • Revised the width of sink dimensions • Added dishwasher requirements • Oven/Stove Range may be electric or gas by homeowner option • Oven/Stove Range added stainless steel as a color option • Refrigerator added stainless steel as a color option • Added options for cabinetry: recessed, shaker, or flat • Added cabinetry requirements for Single Family Home Repair Program, single family homes developed under the CHDO program, and New Home Development Program • Added option for wheelchair accessible bathroom for single family housing units with 2 or more bathrooms • Added an alternate to linen closet for master bathroom • Added types of doors for vanities: recessed, shaker or flat panel • Added that medicine cabinet is optional • Added all water heaters must be vented • Added that all penetrating roof vents and led jacks must match the color of roof shingles • Added all tank-less water heaters require HCDD approval • Added all shower heads/ shower wands must have a flow rate no greater than 2 gpm. • Added all front entry doors must be 36 inches wide and must be solid core wood, steel, or insulated fiberglass • Added all rear entry doors must be 32 inches wide and must be solid core wood, steel, and insulated fiberglass. • Added the 36 inches width requirement for all doors (front, rear, and interior doors) in an ADA accessible home

Version	Date Adopted	Changes
		<ul style="list-style-type: none"> • Added STC requirements for exterior doors • Revised width requirements for pantry doors and closet doors to 24 inches • Decreased fire rating for every interior door to 20 minutes <p>Stairs, Hallways, Handrails, Guardrails, & Ramps</p> <ul style="list-style-type: none"> • Revised that stairways and steps of 2 or more risers must have at least one handrail • Increased the height of a stair/step riser to 7.75 inches • Removed the 2 coats of Thompson Water Seal or equal product for porches, balconies, decks, and ramps <p>Waterways, Driveways, and Entry</p> <ul style="list-style-type: none"> • Reduced the reinforcement requirements for driveways to 2500 pounds per square inch <p>Minimum Standards for Ventilation</p> <ul style="list-style-type: none"> • Increased the requirements for intermittent exhaust fans to 80 cfm • Removed that the location of cable/phone prewiring will be determined by the program <p>Minimum Standards for Electrical Service</p> <ul style="list-style-type: none"> • Added prewire for cable and Cat-5 requirements • Added pre-wire for an alarm system • Removed the Can and Air Tight requirements for recessed lights • Added all ceiling fans must have light kits and acceptable manufactures <p>Minimum Standards for Heating</p> <ul style="list-style-type: none"> • Approval required from HCDD sealed combustion system when heating system source is burning liquid or gaseous fuels located in any habitable room, bathroom, toilet room, storage closet, and attic space • Added all AC packages must include a 4” thick concrete pad <p>Energy Conservation</p> <ul style="list-style-type: none"> • Added compliance with the current International Energy Conservation Code (IECC) for newly constructed structures. • Added installation of weather stripping for attic access • Removed the requirement for 6 panel for Exterior doors, replaced with metal clad insulated doors

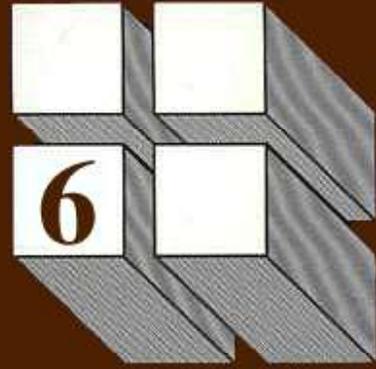
Version	Date Adopted	Changes
		<ul style="list-style-type: none"> • Added caulking around the exterior doors and windows at foundation sill plate. • Added all windows to either be single-hung or fixed • Added all windows within 2 feet of any door, must be tempered • Added that 2” black or white venetian blinds on all windows • Added scuttle hole will be allowed where no appliances in the attic • Added where appliances in the attic, a pull downstairs with a weight rating of 300lbs <p>Minimum Standards for the Interiors of Structures</p> <ul style="list-style-type: none"> • Removed the requirements of installing a sealed kick plate around vanities and cabinets in bathrooms and kitchens • All vinyl plank flooring at least 1/8” thick • Reduced ounce per square yard to 25 and decreased density of carpet pad to 6lbs. • Added interior walls may be smooth or textured • Increased minimum size for bedroom with closet to 121 • Updated requirements for wall and ceiling paint, including acceptable manufactures • Semi-gloss or gloss paint on all trim and woodwork <p>Minimum Standards for Exterior of Structures</p> <ul style="list-style-type: none"> • Removed composite or UV resilient vinyl material requirements for construction skirting • Removed concrete pour requirements on grade foundation • Decreased concrete requirements to 2500 pounds per square inch • Added architectural shingles over 30lbs felt, generic synthetic felt, or equivalent product must provide a limited lifetime • Updated roofing requirement to include acceptable products • Added that trees and shrubs installed must be from the City of Houston tree and shrub list <p>Minimum Standards for Plumbing Systems</p> <ul style="list-style-type: none"> • Added all plumbing fixtures must be approved by prospective homebuyer or homeowner

Version	Date Adopted	Changes
		<ul style="list-style-type: none"> • Removed the requirement for Water Sense qualified or better plumbing fixture • Removed elongated toilets as a requirement
5.4	March 28, 2024	<p>Movement of text from Minimum Standards for Exterior of Structures (General Framing) Section A to Section B</p> <p>Changed document title from “Minimum Construction Standards” to “Minimum Construction Standards for Rehabilitation, Reconstruction and New Construction for Single Family Residences”</p>

APPENDIX A: Prescriptive Residential Wood Deck Construction Guide

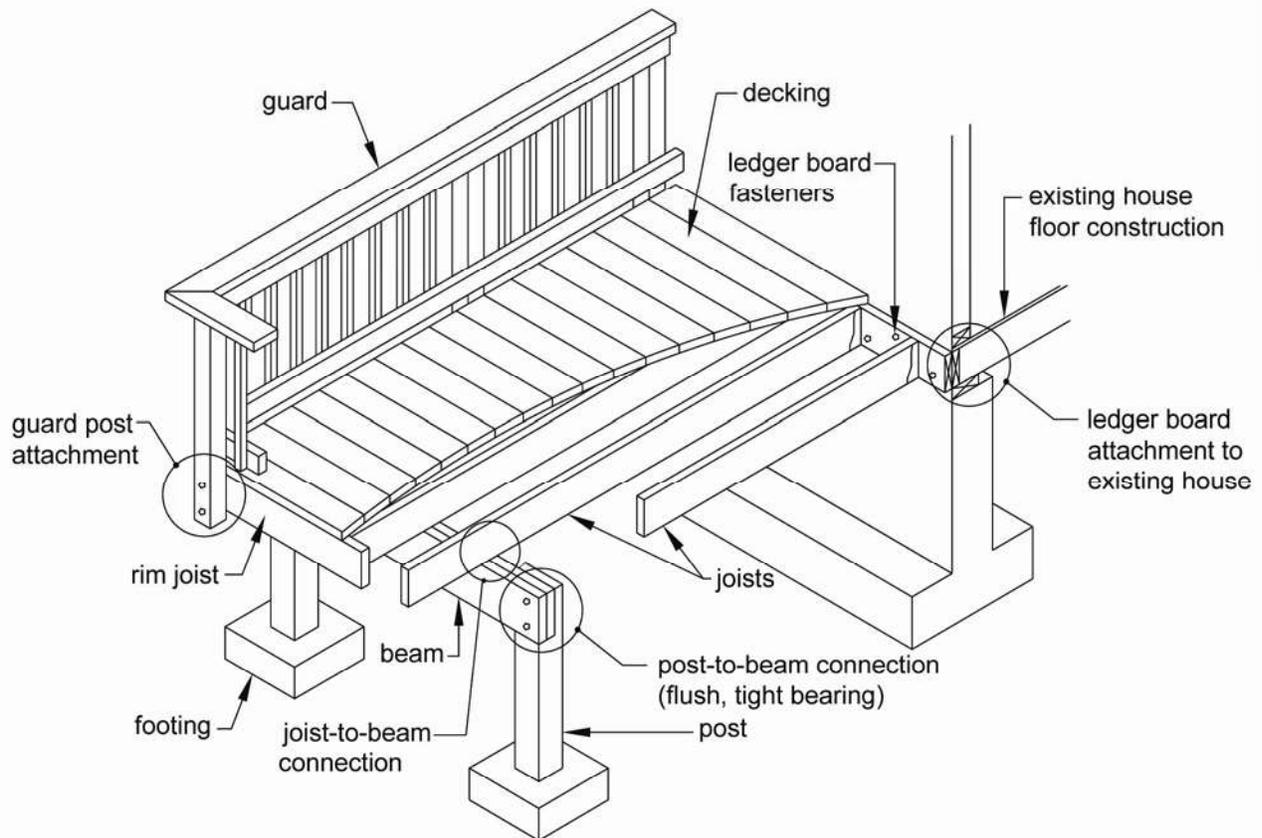
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Design for Code Acceptance



Prescriptive Residential Wood Deck Construction Guide

Based on the *2009 International Residential Code*



Where applicable, provisions and details contained in this document are based on the *International Residential Code (IRC)* [bracketed text references applicable sections of the *IRC*]. Prescriptive construction methods recommended meet or exceed minimum requirements of the *IRC*. Provisions that are not found in the *IRC* are recommended as good industry practice. Where differences exist between provisions of this document and the *IRC*, provisions of the *IRC* shall apply. This document is not intended to preclude the use of other construction methods or materials. All construction and materials must be approved by the authority having jurisdiction. Every effort has been made to reflect the language and intent of the *IRC*. However, no assurance can be given that designs and construction made in accordance with this document meet the requirements of any particular jurisdiction.

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MINIMUM REQUIREMENTS

- This document applies to single level residential wood decks only.
- All lumber shall be identified by the grade mark of, or certificate of inspection issued by, an approved lumber grading or inspection bureau or agency (www.alsc.org). All lumber shall be a naturally durable species (such as Redwood or Western Cedars) or be pressure-treated with an approved process and preservative in accordance with American Wood Protection Association standards (such as but not limited to those shown in Table 1) [R317 and R318]. All lumber in contact with the ground shall be approved preservative treated wood suitable for ground contact. [R317.1.2]
- All nails shall meet the requirements of *ASTM F 1667*. Threaded nails as stated in this document include helical (spiral) and annular (ring-shank) nails. Wood screws shall meet the requirements of *ANSI/ASME B18.6.1*. Bolts and lag screws shall meet the requirements of *ANSI/ASME B18.2.1*.
- Throughout this document, ½" diameter bolts and lag screws are specified for various connections. Edge distance and spacing requirements are based on ½" diameter fasteners. If larger (or smaller) fasteners are specified, edge distance and spacing needs to be adjusted.
- To resist corrosion, the following is required [R317.3]:
 - All screws, bolts, and nails for use with preservative treated wood shall be hot-dipped zinc-coated galvanized steel, stainless steel, silicon bronze, or copper. Fasteners to be hot-dipped galvanized shall meet the requirements of *ASTM A 153, Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware, Class D* for fasteners 3/8" diameter and smaller or Class C for fasteners with diameters over 3/8".
 - Fasteners other than nails and timber rivets shall be permitted to be of mechanically deposited zinc-coated steel with coating weights in accordance with *ASTM B 695, Class 55*, minimum.
 - All hardware (joist hangers, cast-in-place post anchors, etc.) shall be galvanized or shall be stainless steel. Hardware to be hot-dipped prior to fabrication shall meet *ASTM A 653, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process, G-185* coating. Hardware to be hot-dipped galvanized after fabrication shall meet *ASTM A123, Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products*.
 - Fasteners and connectors exposed to salt water or located within 300 feet of a salt water shoreline shall be stainless steel grade 304 or 316.
 - Other coated or non-ferrous fasteners or hardware shall be as approved by the authority having jurisdiction.
- Decks supporting large concentrated loads such as hot tubs are beyond the scope of this document.
- This document does not apply to decks which will experience snow loads, snow drift loads, or sliding snow loads that exceed 40 psf. This document does not address wind or seismic design issues.
- Flashing shall be corrosion-resistant metal [R703.8] of minimum nominal 0.019-inch thickness or approved non-metallic material. Aluminum should not be used in direct contact with lumber treated with preservatives that contain copper such as ACQ, Copper Azole, or ACZA.
- Decks shall not be used or occupied until final inspection and approval is obtained.
- This document is not intended to preclude the use of other construction methods or materials not shown herein.

Table 1. Common preservative treatments and retention levels (pcf) for sawn lumber in ground contact.^a

Species	ACQ-B	ACQ-C	ACQ-D	CA-B	CuN-W
Southern Pine	0.40	0.40	0.40	0.21	0.11
Douglas Fir-Larch	0.40	0.40	NR	0.21	0.11
Hem-Fir	0.40	0.40	0.40	0.21	0.11
Ponderosa Pine	0.40	0.40	0.40	0.21	0.11
Red Pine	0.40	0.40	0.40	0.21	0.11
Spruce-Pine-Fir	NR	0.40	NR	NR	NR
Redwood	NR	NR	NR	NR	NR

^a Preservatives and retentions listed in Table 1 are based on the American Wood Protection Association (AWPA) *Book of Standards*. NR = Treatments Not Recommended.

DECKING REQUIREMENTS

All decking material shall be composed of dimension lumber (2" nominal thickness) or span rated decking in accordance with the American Lumber Standard Committee *Policy for Evaluation of Recommended Spans for Span Rated Decking Products (November 5, 2004)*. Attach decking to each joist with 2-8d threaded nails or 2-#8 screws. Space decking boards approximately 1/8" apart. See Figure 11 for decking connection requirements at the rim joist. Decking may be placed from an angle perpendicular to the joists to an angle of 45 degrees to the joists. Each segment of decking must bear on a minimum of 4 joists (or 4 supports).

Decking not meeting these requirements may be substituted when the product has been approved by the authority having jurisdiction.

JOIST SIZE

The span of a joist is measured from the centerline of bearing at one end of the joist to the centerline of bearing at the other end of the joist and does not include the length of the overhangs. Use Table 2 to determine joist span based on lumber size and joist spacing. See Figure 1 and Figure 2 for joist span types.

Table 2. Maximum Joist Spans (L_J)

Species	Size	Joist Spacing (o.c.)					
		Without Overhangs ¹			With Overhangs up to L _J /4 ²		
		12"	16"	24"	12"	16"	24"
Southern Pine	2x8	13' - 8"	12' - 5"	10' - 2"	10' - 9"	10' - 9"	10' - 2"
	2x10	17' - 5"	15' - 10"	13' - 1"	15' - 6"	15' - 6"	13' - 1"
	2x12	18' - 0"	18' - 0"	15' - 5"	18' - 0"	18' - 0"	15' - 5"
Douglas Fir-Larch, Hem-Fir, SPF ³	2x8	12' - 6"	11' - 1"	9' - 1"	9' - 5"	9' - 5"	9' - 1"
	2x10	15' - 8"	13' - 7"	11' - 1"	13' - 7"	13' - 7"	11' - 1"
	2x12	18' - 0"	15' - 9"	12' - 10"	18' - 0"	15' - 9"	12' - 10"
Redwood, Western Cedars, Ponderosa Pine ⁴ , Red Pine ⁴	2x8	11' - 8"	10' - 7"	8' - 8"	8' - 6"	8' - 6"	8' - 6"
	2x10	14' - 11"	13' - 0"	10' - 7"	12' - 3"	12' - 3"	10' - 7"
	2x12	17' - 5"	15' - 1"	12' - 4"	16' - 5"	15' - 1"	12' - 4"

1. Assumes 40 psf live load, 10 psf dead load, L/360 deflection, No. 2 grade, and wet service conditions. See Figure 1B.

2. Assumes 40 psf live load, 10 psf dead load, L/180 cantilever deflection with 220 lb point load, No. 2 grade, and wet service conditions. See Figure 1A and Figure 2.

3. Incising assumed for refractory species including Douglas fir-larch, hem-fir, and spruce-pine-fir.

4. Design values based on northern species with no incising assumed.

Figure 1A. Joist Span – Deck Attached at House and Bearing Over Beam

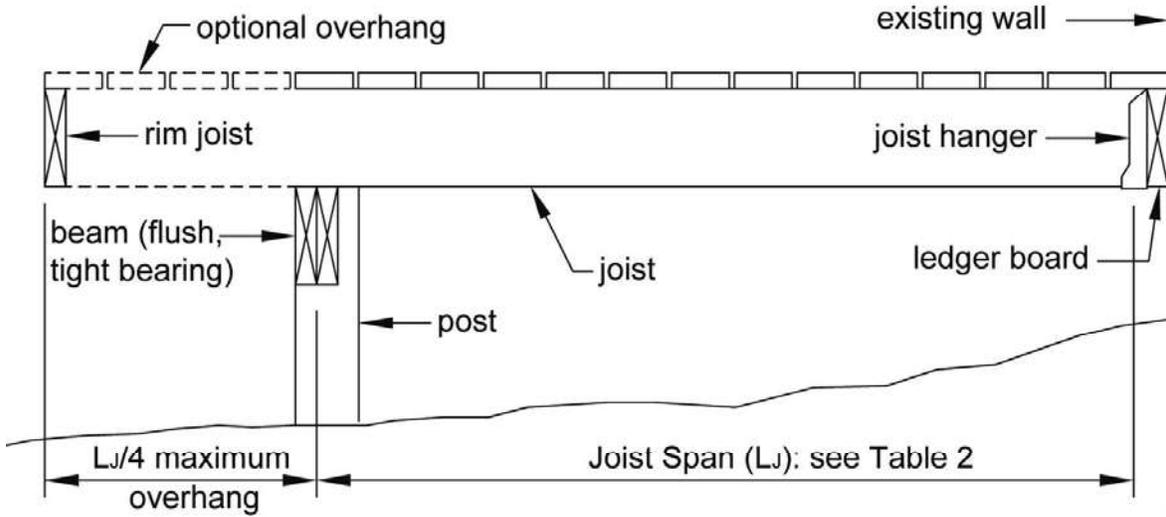


Figure 1B. Joist Span – Joists Attached at House and to Side of Beam

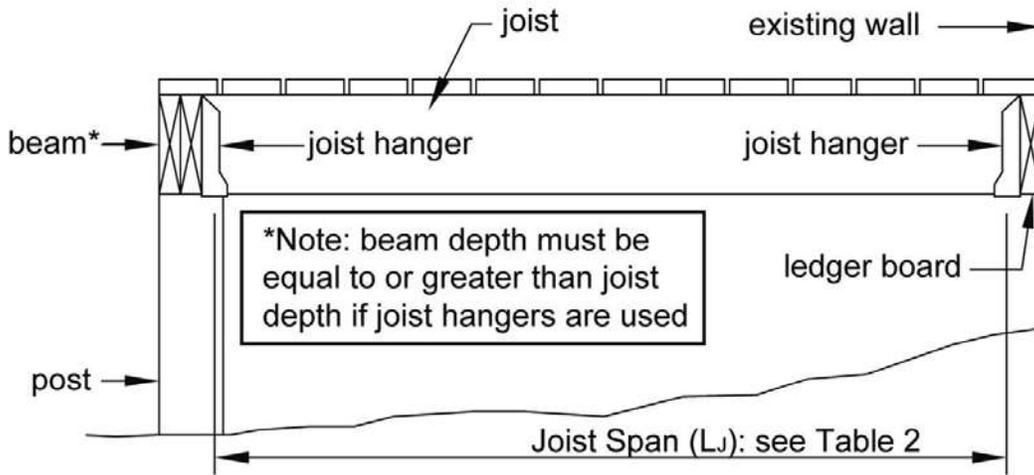
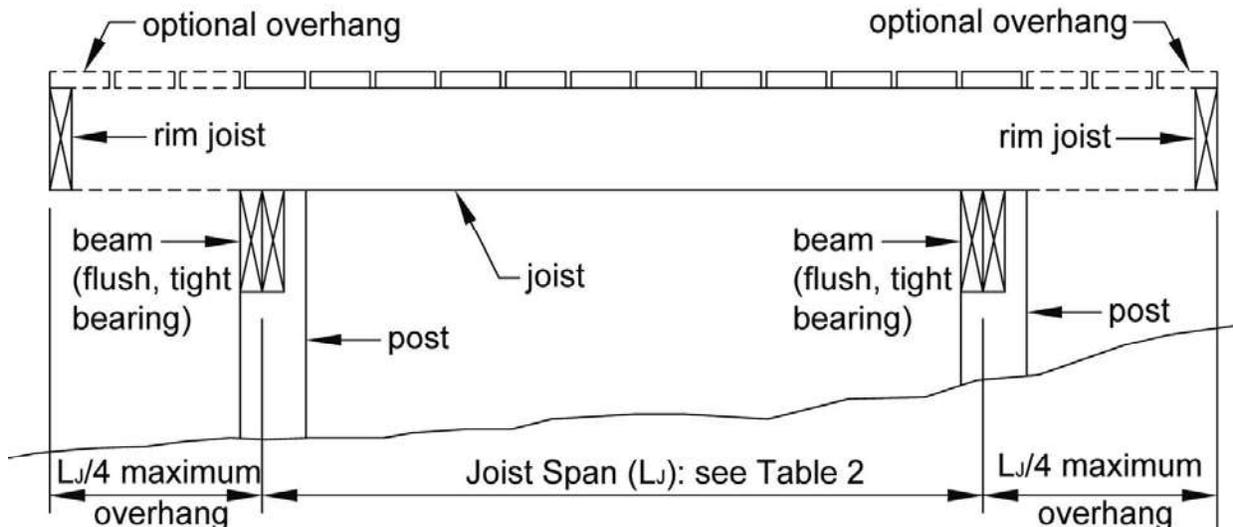


Figure 2. Joist Span – Free Standing Deck



BEAM SIZE & ASSEMBLY REQUIREMENTS

Deck beam spans shall be in accordance with Table 3 and can extend past the post centerline up to $L_B/4$ as shown in Figure 3. Joists may bear on the beam and extend past the beam centerline up to $L_J/4$ as shown in Figures 1A and 2, or the joists may attach to the side of the beam with joist hangers as shown in Figure 1B.

Joists shall not frame in from opposite sides of the same beam. See JOIST-TO-BEAM CONNECTION details, Figure 6.

Where multiple 2x members are used, the deck's beam is assembled by attaching the members identified in Table 3 in accordance with Figure 4. [Table R602.3(1)]

Table 3. Deck Beam Spans (L_B)¹ for Joists Framing from One Side Only

Species	Size ⁴	Joist Spans (L_J) Less Than or Equal to:						
		6'	8'	10'	12'	14'	16'	18'
Southern Pine	2-2x6	7' - 1"	6' - 2"	5' - 6"	5' - 0"	4' - 8"	4' - 4"	4' - 1"
	2-2x8	9' - 2"	7' - 11"	7' - 1"	6' - 6"	6' - 0"	5' - 7"	5' - 3"
	2-2x10	11' - 10"	10' - 3"	9' - 2"	8' - 5"	7' - 9"	7' - 3"	6' - 10"
	2-2x12	13' - 11"	12' - 0"	10' - 9"	9' - 10"	9' - 1"	8' - 6"	8' - 0"
	3-2x6	8' - 7"	7' - 8"	6' - 11"	6' - 3"	5' - 10"	5' - 5"	5' - 2"
	3-2x8	11' - 4"	9' - 11"	8' - 11"	8' - 1"	7' - 6"	7' - 0"	6' - 7"
	3-2x10	14' - 5"	12' - 10"	11' - 6"	10' - 6"	9' - 9"	9' - 1"	8' - 7"
	3-2x12	17' - 5"	15' - 1"	13' - 6"	12' - 4"	11' - 5"	10' - 8"	10' - 1"
Douglas Fir-Larch ² , Hem-Fir ² , SPF ² , Redwood, Western Cedars, Ponderosa Pine ³ , Red Pine ³	3x6 or 2-2x6	5' - 5"	4' - 8"	4' - 2"	3' - 10"	3' - 6"	3' - 1"	2' - 9"
	3x8 or 2-2x8	6' - 10"	5' - 11"	5' - 4"	4' - 10"	4' - 6"	4' - 1"	3' - 8"
	3x10 or 2-2x10	8' - 4"	7' - 3"	6' - 6"	5' - 11"	5' - 6"	5' - 1"	4' - 8"
	3x12 or 2-2x12	9' - 8"	8' - 5"	7' - 6"	6' - 10"	6' - 4"	5' - 11"	5' - 7"
	4x6	6' - 5"	5' - 6"	4' - 11"	4' - 6"	4' - 2"	3' - 11"	3' - 8"
	4x8	8' - 5"	7' - 3"	6' - 6"	5' - 11"	5' - 6"	5' - 2"	4' - 10"
	4x10	9' - 11"	8' - 7"	7' - 8"	7' - 0"	6' - 6"	6' - 1"	5' - 8"
	4x12	11' - 5"	9' - 11"	8' - 10"	8' - 1"	7' - 6"	7' - 0"	6' - 7"
	3-2x6	7' - 4"	6' - 8"	6' - 0"	5' - 6"	5' - 1"	4' - 9"	4' - 6"
	3-2x8	9' - 8"	8' - 6"	7' - 7"	6' - 11"	6' - 5"	6' - 0"	5' - 8"
	3-2x10	12' - 0"	10' - 5"	9' - 4"	8' - 6"	7' - 10"	7' - 4"	6' - 11"
	3-2x12	13' - 11"	12' - 1"	10' - 9"	9' - 10"	9' - 1"	8' - 6"	8' - 1"

1. Assumes 40 psf live load, 10 psf dead load, L/360 simple span beam deflection limit, L/180 cantilever deflection limit, No. 2 grade, and wet service conditions.
2. Incising assumed for refractory species including Douglas fir-larch, hem-fir, and spruce-pine-fir.
3. Design values based on northern species with no incising assumed.
4. Beam depth must be equal to or greater than joist depth if joist hangers are used (see Figure 6, Option 3).

Figure 3: Beam Span Types

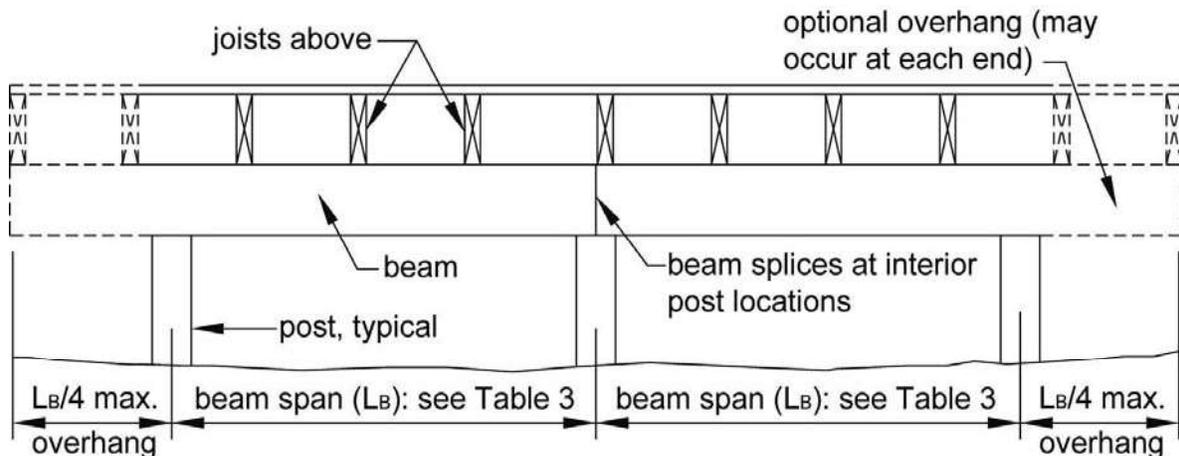
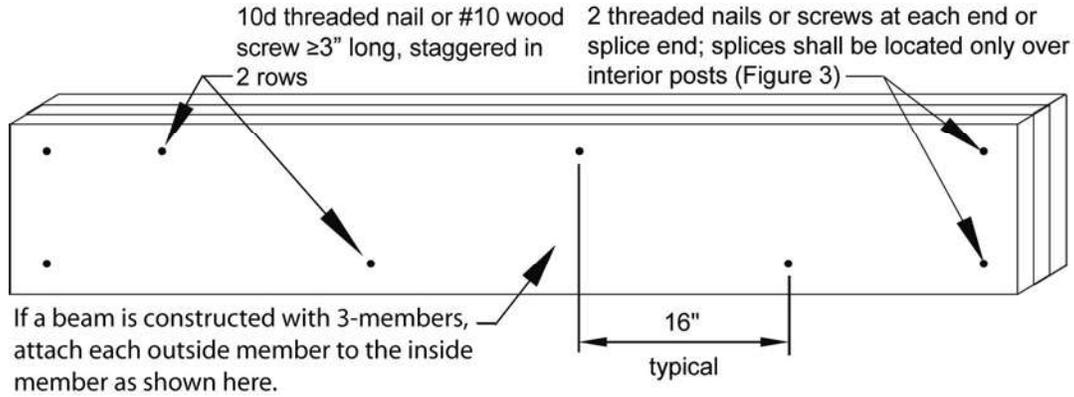


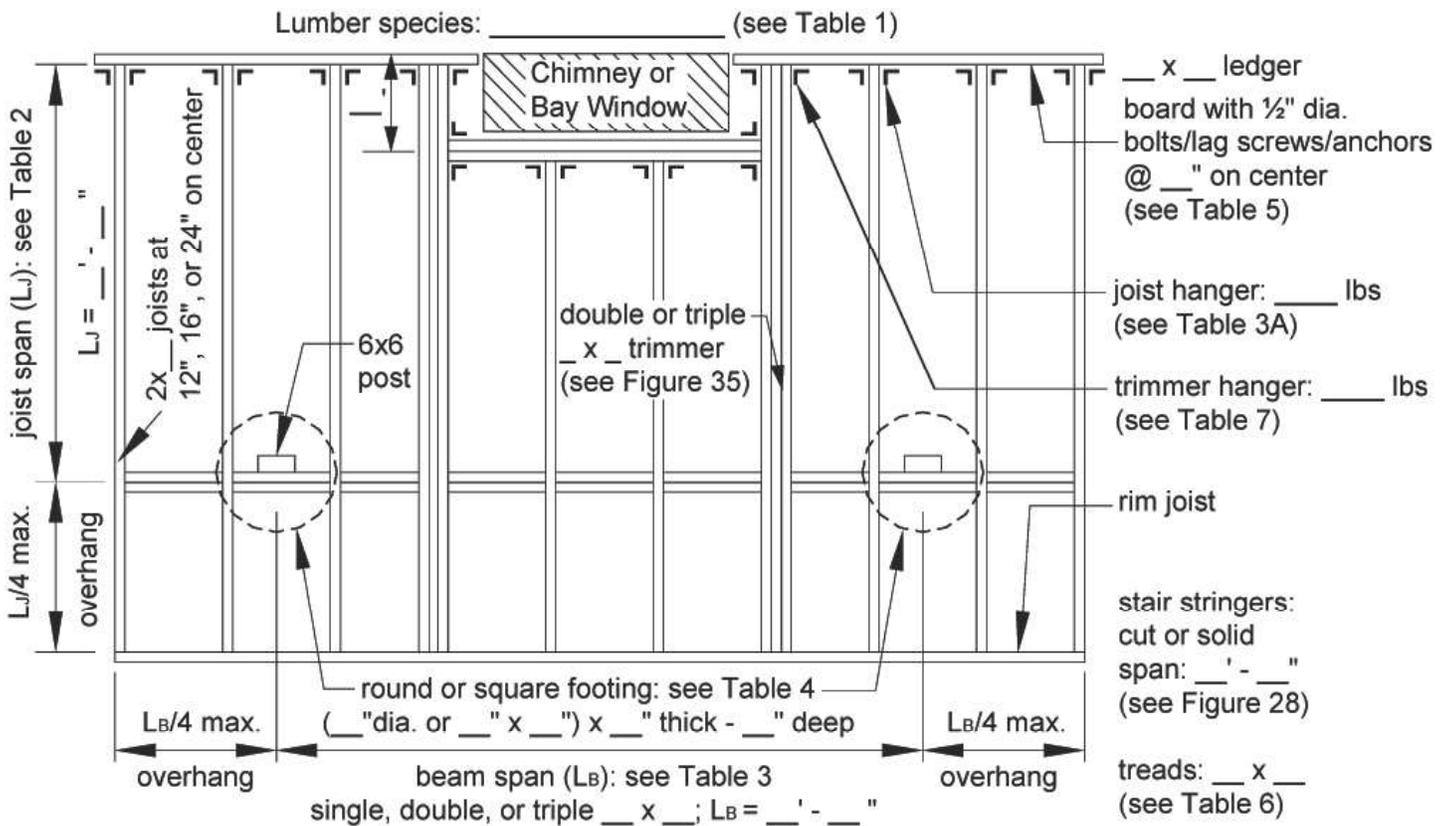
Figure 4. Beam Assembly Details



DECK FRAMING PLAN

A framing plan shows the joist and beam layout; the location of the ledger board, posts, and footings, and the type, size, and spacing of the ledger board fasteners. See Figure 5 for an example of a typical deck framing plan.

Figure 5. Typical Deck Framing Plan

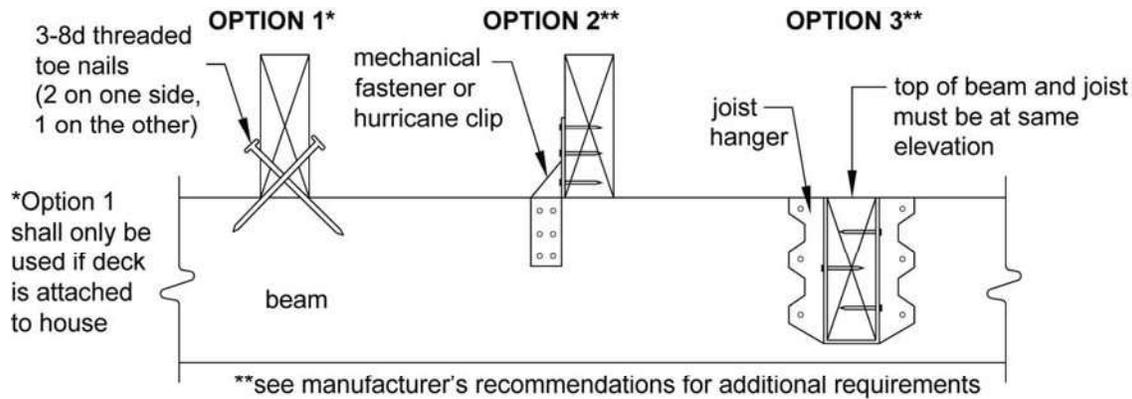


JOIST-TO-BEAM CONNECTION

Each joist shall be attached to the beam as shown in Figure 6. Joists may bear on and overhang past the beam a maximum of $L_j/4$. Use Option 1 or Option 2 to attach the joist to the beam. Option 1 shall only be used if the deck is attached to the house with a ledger (see LEDGER ATTACHMENT REQUIREMENTS) or as shown in Figure 23. Mechanical fasteners or hurricane

clips used as shown in Option 2 must have a minimum capacity of 100 lbs in both uplift and lateral load directions. Joists may also attach to the side of the beam with joist hangers per Option 3. Joists shall not frame in from opposite sides of the same beam. See JOIST HANGERS for more information. Hangers, clips, and mechanical fasteners shall be galvanized or stainless steel (see MINIMUM REQUIREMENTS).

Figure 6: Joist-to-Beam Detail



JOIST HANGERS

Joist hangers, as shown in Figure 7, shall each have a minimum download capacity in accordance with Table 3A. The joist hanger shall be selected from an approved manufacturer's product data based on the dimensions of the joist or header it is carrying. Joist hangers shall be galvanized or stainless steel (see MINIMUM REQUIREMENTS).

Use joist hangers with inside flanges when clearances to the edge of the beam or ledger board dictate. **Do not use clip angles or brackets to support joists.**

Figure 7: Typical Joist Hangers

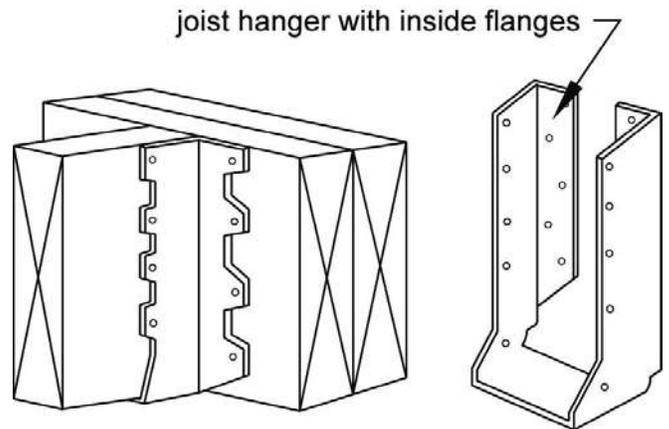


Table 3A: Joist Hanger Download Capacity

Joist Size	Minimum Capacity, lbs
2x8	600
2x10	700
2x12	800

POST REQUIREMENTS

All deck post sizes shall be 6x6 (nominal) or larger, and the maximum height shall be 14'-0" measured to the underside of the beam. Posts shall be centered on footings. Cut ends of posts shall be field treated with an approved preservative (such as copper naphthenate) [R402.1.2]. The beam shall be attached to the post by

notching the 6x6 as shown in Figure 8 or by providing an approved post cap to connect the beam and post as shown in Figure 10. All 3-ply beams shall be connected to the post by a post cap. All thru-bolts shall have washers under the bolt head and nut. Attachment of the beam to the side of the post without notching is prohibited (see Figure 9).

Figure 8. Post-to-Beam Attachment Requirements

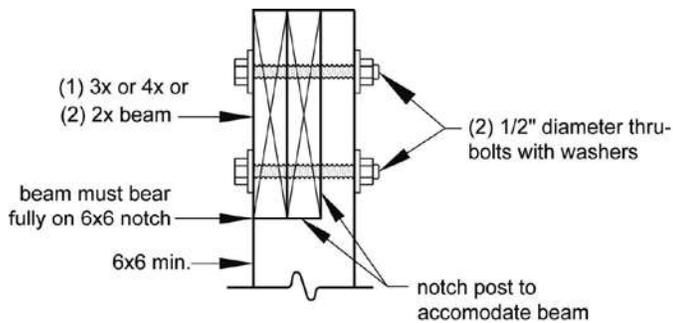
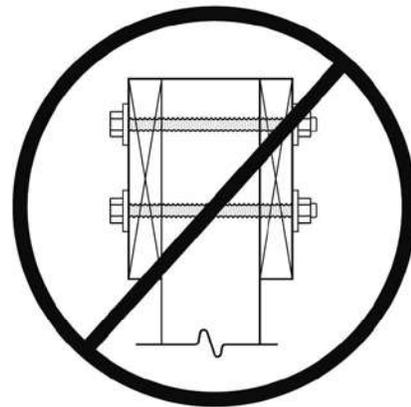


Figure 9. Prohibited Post-to-Beam Attachment Condition



RIM JOIST REQUIREMENTS

Attach a continuous rim joist to the ends of joists as shown in Figure 11. Attach decking to the rim joist as shown in Figure 11. For more decking attachment requirements, see DECKING REQUIREMENTS.

Figure 10. Alternate Approved Post-to-Beam Post Cap Attachment

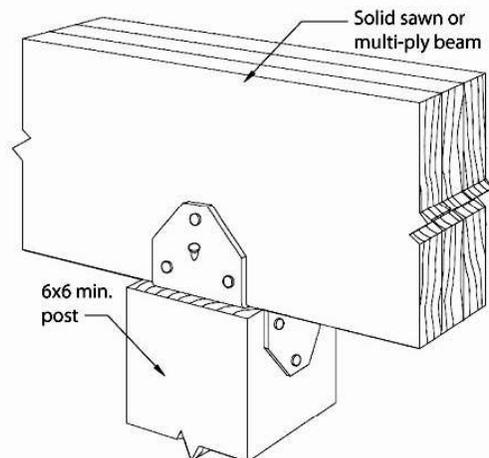
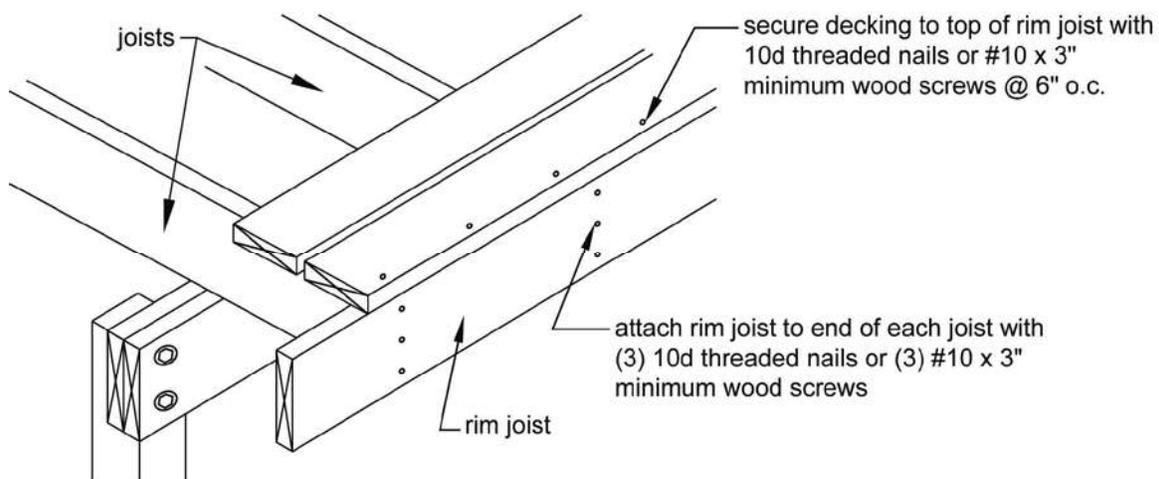


Figure 11. Rim Joist Connection Details



FOOTINGS [R403]

See Figure 12 and Table 4 for footing size, footing thickness, and post attachment options and requirements. All footings shall bear on solid ground and shall be placed at least 12 inches below the undisturbed ground surface or below the frost line, whichever is deeper. Contact the authority having jurisdiction to determine the specified frost line. Bearing conditions shall be verified in the field by the building official prior to placement of concrete. Where the building official determines that in-place soils with an allowable bearing capacity of less than 1,500 psf are likely to be present at the site, the allowable bearing capacity shall be determined by a soils investigation. DECK FOOTINGS CLOSER THAN 5'-0" TO AN EXISTING EXTERIOR HOUSE WALL MUST BEAR AT THE SAME ELEVATION AS THE FOOTING OF THE EXISTING HOUSE FOUNDATION.

Do not construct footings over utility lines or enclosed meters. Contact local utilities (call 811) before digging.

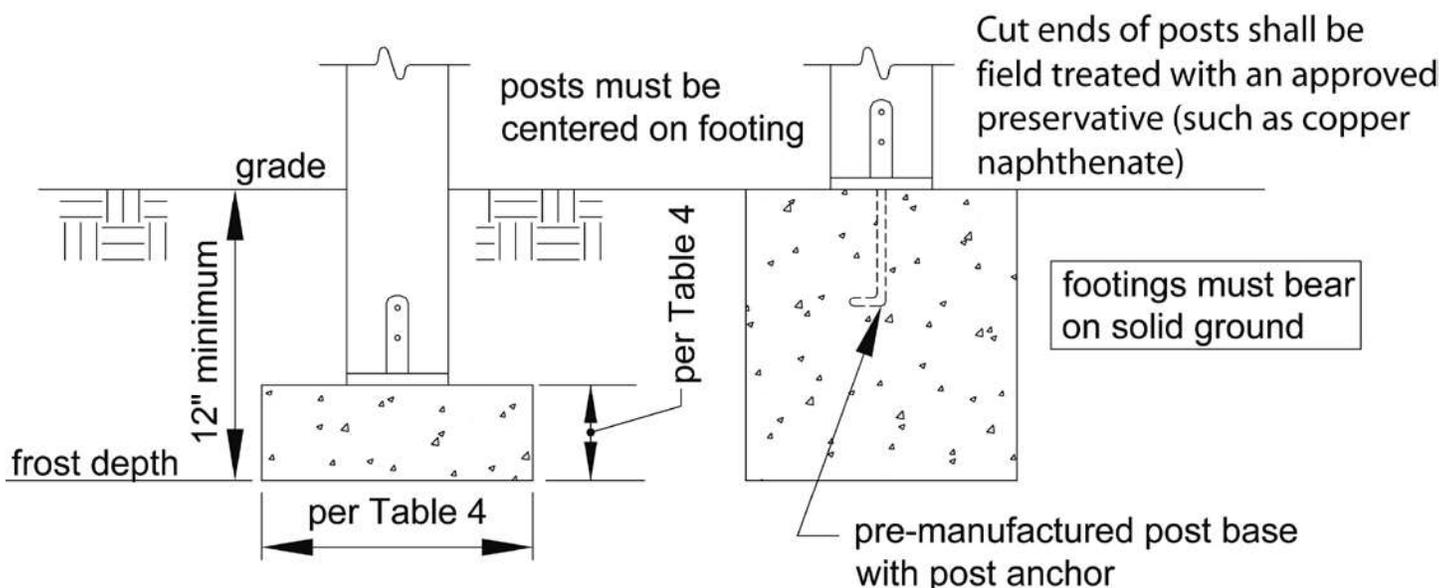
Pre-manufactured post anchors shall be galvanized. See MINIMUM REQUIREMENTS.

Table 4. Footing Sizes¹

Beam Span, L _B	Joist Span L _J	Round Footing Diameter	Square Footing Dimension	Footing Thickness ²
6'	<10'	15"	13"	6"
	<14'	17"	15"	6"
	<18'	20"	18"	7"
8'	<10'	17"	15"	6"
	<14'	20"	18"	8"
	<18'	23"	21"	9"
10'	<10'	19"	17"	7"
	<14'	22"	20"	9"
	<18'	25"	23"	10"
12'	<10'	21"	19"	8"
	<14'	24"	22"	10"
	<18'	28"	26"	11"
14'	<10'	22"	20"	9"
	<14'	26"	24"	11"
	<18'	30"	28"	12"
16'	<10'	24"	22"	9"
	<14'	28"	26"	12"
	<18'	32"	30"	13"
18'	<10'	25"	23"	10"
	<14'	30"	28"	12"
	<18'	34"	32"	14"

1. Assumes 1,500 psf soil bearing capacity.
2. Assumes 2,500 psi compressive strength of concrete. Coordinate footing thickness with post base and anchor requirements.

Figure 12. Typical Footing Options



LEDGER ATTACHMENT REQUIREMENTS**[R502.2.2]**

GENERAL: Attach the ledger board, which shall be equal to or greater than the deck joist depth but less than or equal to the rim joist depth, to the existing exterior wall in accordance with Figure 14 through Figure 16. When attachments are made to the existing house band joist, the band joist shall be capable of supporting the new deck. If this cannot be verified or conditions at the existing house differ from the details herein, then either a free-standing deck or full plan submission is required. See FREE-STANDING DECKS.

SIDING AND FLASHING: House siding or the exterior finish system must be removed prior to installation of the ledger board. Approved corrosion resistant flashing is required at any ledger board connection to a wall of wood framed construction (see MINIMUM REQUIREMENTS). See Figure 14 for continuous flashing with drip edge. The threshold shall be carefully flashed and caulked to prevent water intrusion due to splash from the deck or melting snow and ice.

MANUFACTURED WOOD I-JOIST: The term “I-Joist” denotes manufactured wood “I” joists (see Figure 13A). Many new homes constructed with wood I-joists

include 1" or thicker engineered wood products (EWP) – such as oriented strand board (OSB) or structural composite lumber (SCL) including laminated veneer lumber (LVL) – as band joists (or rim boards) that can support the attachment of a deck (see Figure 14). However, some older homes might be constructed with band boards that are too thin (less than 1") to support a deck. In such cases, a free-standing deck or a full plan submission is required.

MANUFACTURED WOOD TRUSS: A metal plate connected wood truss (MPCWT) is an engineered, prefabricated structural component designed for each specific application. MPCWT's used in residential floors are often installed with a 2x4 lumber “ribbon” at the ends of the trusses (see Figure 13B) to tie the ends of the trusses together. The ribbon board, by itself, is not intended to support the deck ledger and deck. Installing residential decks when the floor system for the house uses MPCWT requires a standard detail provided by the truss designer, a free-standing deck, or a full plan submission. Refer to the WTCA Technical Note – *Attachment of Residential Decks to Wood Truss Floor Systems* for special blocking details and attachment requirements (www.sbcindustry.com).

Figure 13A. Wood I-Joist Profile

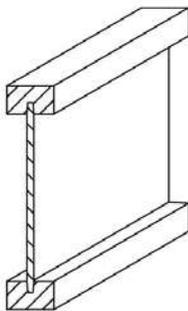


Figure 13B. Metal Plate Connected (MPC) Wood Floor Trusses with a 2x4 Lumber “Ribbon” at the Ends of the Trusses

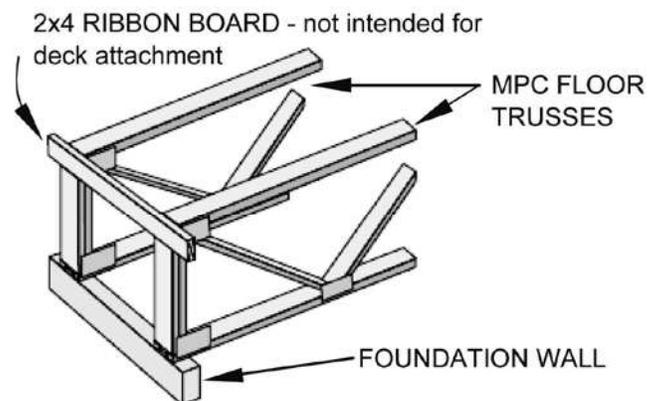


Figure 14. General Attachment of Ledger Board to Band Joist or Rim Board

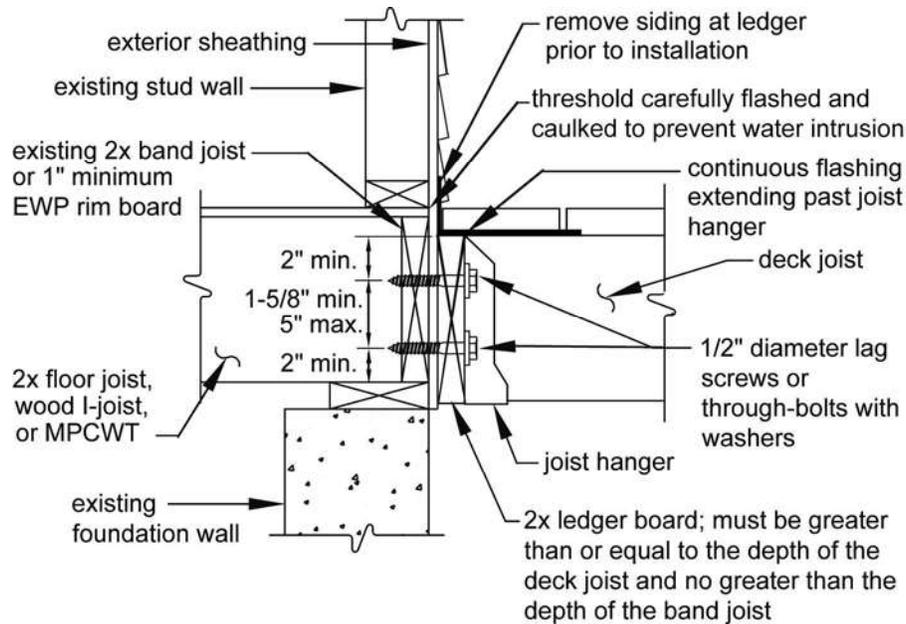


Figure 15. Attachment of Ledger Board to Foundation Wall (Concrete or Solid Masonry)

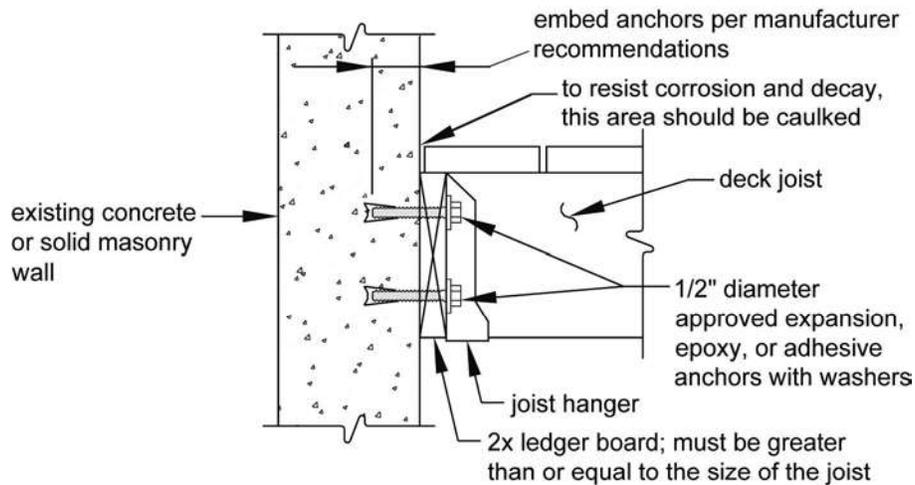
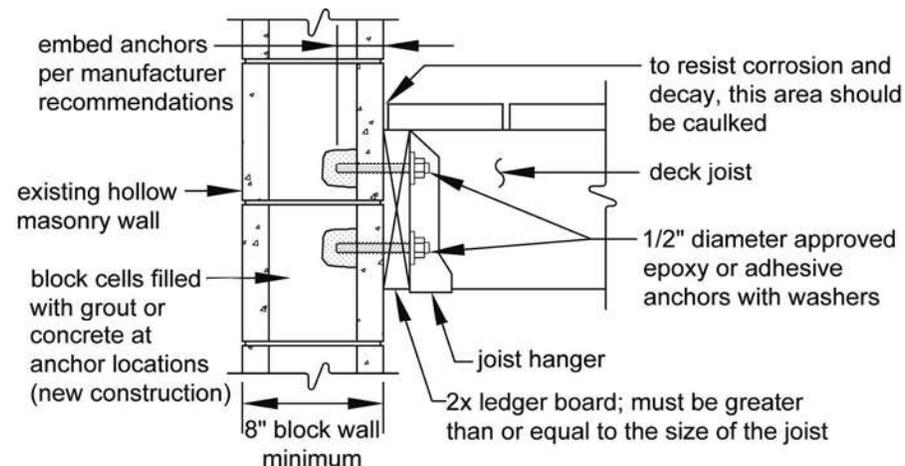


Figure 16. Attachment of Ledger Board to Foundation Wall (Hollow Masonry)



PROHIBITED LEDGER ATTACHMENTS

Attachments to exterior veneers (brick, masonry, stone) and to cantilevered floor overhangs or bay windows are prohibited (see Figures 17 and 18). In such cases the

deck shall be free-standing (see FREE-STANDING DECKS).

Figure 17. No Attachment to or Through Exterior Veneers (Brick, Masonry, Stone)

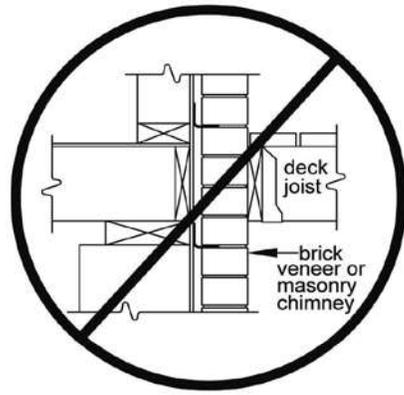


Figure 18. No Attachment to House Overhang



LEDGER BOARD FASTENERS

Only those fasteners noted below are permitted. LEAD ANCHORS ARE PROHIBITED.

Deck ledger connection to band joist or rim board.
The connection between a deck ledger and a 2-inch

nominal lumber band joist (1-1/2" actual) or EWP rim board bearing on a sill plate or wall plate shall be constructed with 1/2" lag screws or bolts with washers per Table 5 and Figure 19 (see MINIMUM REQUIREMENTS).

Table 5. Fastener Spacing for a Southern Pine, Douglas Fir-Larch, or Hem-Fir Deck Ledger and a 2-inch Nominal Solid-Sawn Spruce-Pine-Fir^{7,9} Band Joist or EWP Rim Board⁶

(Deck Live Load = 40 psf, Deck Dead Load = 10 psf)^{3,6}

Joist Span	Rim Board or Band Joist	6'-0" and less	6'-1" to 8'-0"	8'-1" to 10'-0"	10'-1" to 12'-0"	12'-1" to 14'-0"	14'-1" to 16'-0"	16'-1" to 18'-0"
Connection Details		On-Center Spacing of Fasteners^{4,5}						
1/2" diameter lag screw with 15/32" maximum sheathing¹	1" EWP ⁶	24"	18"	14"	12"	10"	9"	8"
	1-1/8" EWP ⁶	28"	21"	16"	14"	12"	10"	9"
	1-1/2" Lumber ^{7,9}	30"	23"	18"	15"	13"	11"	10"
1/2" diameter bolt with 15/32" maximum sheathing	1" EWP ⁶	24"	18"	14"	12"	10"	9"	8"
	1-1/8" EWP ⁶	28"	21"	16"	14"	12"	10"	9"
	1-1/2" Lumber ^{7,9}	36"	36"	34"	29"	24"	21"	19"
1/2" diameter bolt with 15/32" maximum sheathing and 1/2" stacked washers^{2,8}	1" EWP ⁶	24"	18"	14"	12"	10"	9"	8"
	1-1/8" EWP ⁶	28"	21"	16"	14"	12"	10"	9"
	1-1/2" Lumber ^{7,9}	36"	36"	29"	24"	21"	18"	16"

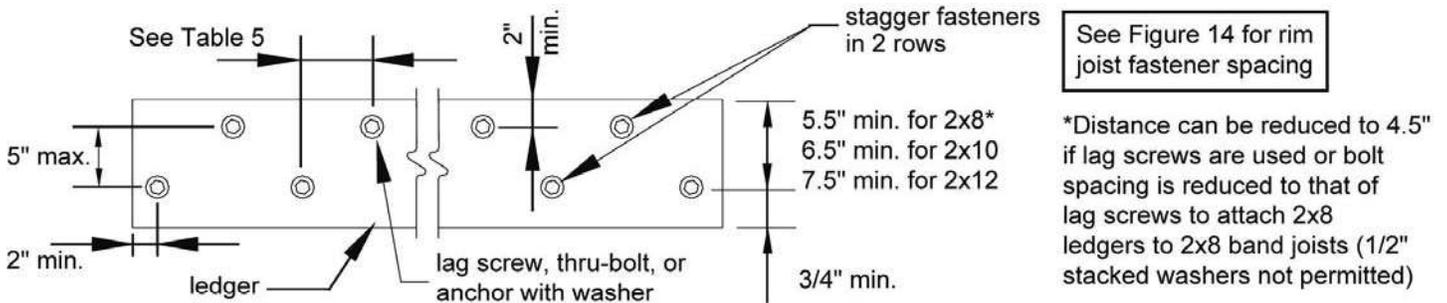
¹ The tip of the lag screw shall fully extend beyond the inside face of the band joist.
² The maximum gap between the face of the ledger board and face of the wall sheathing shall be 1/2".
³ Ledgers shall be flashed or caulked to prevent water from contacting the house band joist (see Figures 14, 15, and 16).
⁴ Lag screws and bolts shall be staggered per Figure 19.
⁵ Deck ledgers shall be minimum 2x8 pressure-preservative-treated No.2 grade lumber, or other approved materials as established by standard engineering practice.
⁶ When solid-sawn pressure-preservative-treated deck ledgers are attached to engineered wood products (minimum 1" thick wood structural panel band joist or structural composite lumber including laminated veneer lumber), the ledger attachment shall be designed in accordance with accepted engineering practice. Tabulated values based on 300 lbs and 350 lbs for 1" and 1-1/8" EWP rim board, respectively.
⁷ A minimum 1"x9 1/2" Douglas fir-larch laminated veneer lumber rim board shall be permitted in lieu of the 2" nominal band joist.
⁸ Wood structural panel sheathing, gypsum board sheathing, or foam sheathing not exceeding one inch thickness shall be permitted. The maximum distance between the face of the ledger board and the face of the band joist shall be one inch.
⁹ Fastener spacing also applies to southern pine, Douglas fir-larch, and hem-fir band joists.

Placement of lag screws or bolts in deck ledgers

The lag screws or bolts shall be placed as shown in Figure 19. The lag screws or bolts shall be staggered from the top to the bottom along the horizontal run of

the deck ledger (see Figure 19). Proper installation of lag screws or bolts shall be verified by the authority having jurisdiction.

Figure 19: Ledger Board Fastener Spacing and Clearances



Thru-Bolts

Thru-bolts shall have a diameter of 1/2". Pilot holes for thru-bolts shall be 17/32" to 9/16" in diameter. Thru-bolts require washers at the bolt head and nut.

Minimum spacing and embedment length shall be per the manufacturer's recommendations. All anchors must have washers.

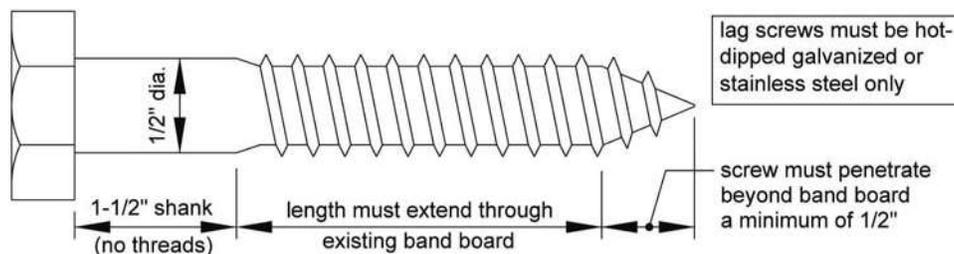
Expansion and Adhesive Anchors

Use approved expansion or adhesive anchors when attaching a ledger board to a concrete or solid masonry wall as shown in Figure 15 or a hollow masonry wall with a grouted cell as shown in Figure 16. Expansion and adhesive anchor bolts shall have a diameter of 1/2".

Lag Screws

Lag screws shall have a diameter of 1/2" (see MINIMUM REQUIREMENTS). Lag screws may be used only when the field conditions conform to those shown in Figure 14. See Figure 20 for lag screw length and shank requirements. All lag screws shall be installed with washers.

Figure 20: Lag Screw Requirements



Lag screw installation requirements: Each lag screw shall have pilot holes drilled as follows: 1) Drill a 1/2" diameter hole in the ledger board, 2) Drill a 5/16" diameter hole into the band board of the existing house. DO NOT DRILL A 1/2" DIAMETER HOLE INTO THE BAND BOARD.

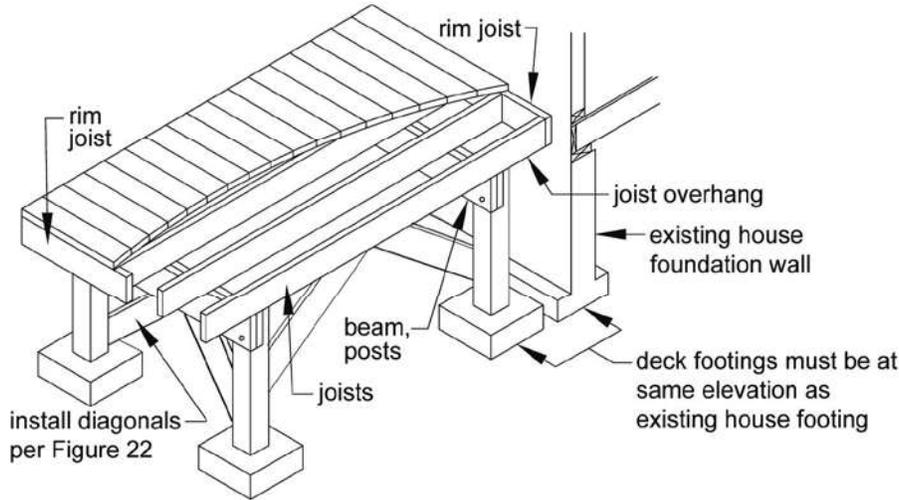
The threaded portion of the lag screw shall be inserted into the pilot hole by turning. DO NOT DRIVE LAG SCREWS WITH A HAMMER. Use soap or a wood-compatible lubricant as required to facilitate tightening. Each lag screw shall be thoroughly tightened (snug but not over-tightened to avoid wood damage).

FREE-STANDING DECKS

Decks which are free-standing do not utilize the exterior wall of the existing house to support vertical loads (see Figure 21); instead, an additional beam with posts is provided at or within L/4 of the existing house. THE ASSOCIATED DECK POST FOOTINGS SHALL BE PLACED AT THE SAME ELEVATION AS THE

EXISTING HOUSE FOOTING IF LOCATED CLOSER THAN 5'-0" TO AN EXISTING HOUSE WALL (see Figure 2 and Figure 12). For houses with basements, a cylindrical footing (caisson) is recommended to minimize required excavation at the basement wall. Beam size is determined by Table 3.

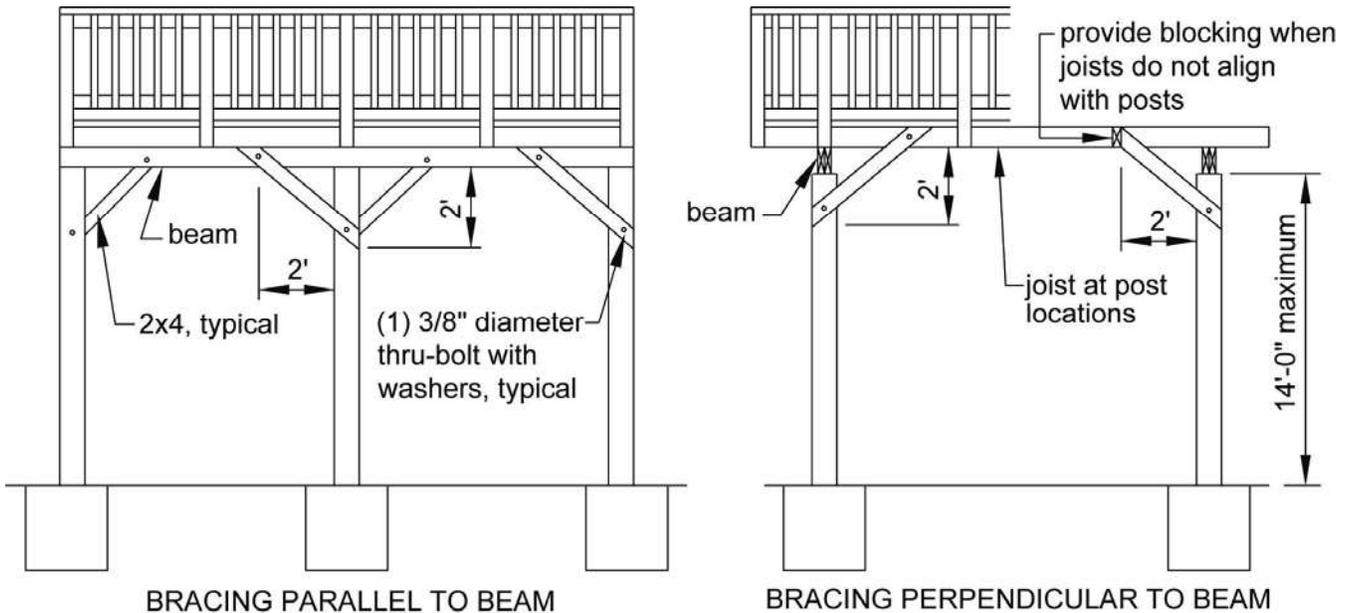
Figure 21. Free-Standing Deck



DECK STABILITY

Decks greater than 2 feet above grade shall be provided with diagonal bracing.

Figure 22. Diagonal Bracing Requirements



Diagonal Bracing: Provide diagonal bracing both parallel and perpendicular to the beam at each post as shown in Figure 22. When parallel to the beam, the bracing shall be bolted to the post at one end and beam at the other. When perpendicular to the beam, the bracing shall be bolted to the post at one end and a joist or blocking between joists at the other. When a joist does not align with the bracing location, provide blocking between the adjacent joists. Decks attached to the house as shown in Figure 23A do not require diagonal bracing perpendicular to the house. Diagonal bracing parallel to the house may be omitted at the beam adjacent to the house for a free-standing deck attached as shown in Figure 23.

Free-standing Deck - Attachment to House: Attach the deck rim joist to the existing house exterior wall as shown in Figure 23 for a free-standing deck. The wall must be sheathed with minimum $\frac{3}{8}$ " wood structural panel sheathing. Use lag screws or thru-bolts when fastening to an existing band joist or wall stud; use expansion anchors or epoxy anchors when fastening to

concrete or masonry. DO NOT ATTACH TO BRICK VENEERS. VERIFY THIS CONDITION IN THE FIELD PRIOR TO UTILIZING THIS METHOD. Fasteners shall be 16" on center and staggered in 2 rows for free-standing decks. Flashing over the rim joist is required and must be installed in accordance with the flashing provisions in the LEDGER ATTACHMENT REQUIREMENTS.

Deck Supported by Ledger - Attachment to House: Where supported by attachment to an exterior wall (Figures 14, 15, or 16), decks shall be positively anchored to the primary structure and designed for both vertical and lateral loads as applicable [R502.2.2]. The lateral load connection required shall be permitted to be in accordance with Figure 23A. Hold down tension devices shall be provided in not less than two locations per deck, and each device shall have an allowable stress design capacity of not less than 1,500 lb [R502.2.2.3]. See the *Commentary* to this document for additional information on applicability of this provision.

Figure 23. Attachment of Free-Standing Deck to House for Deck Stability

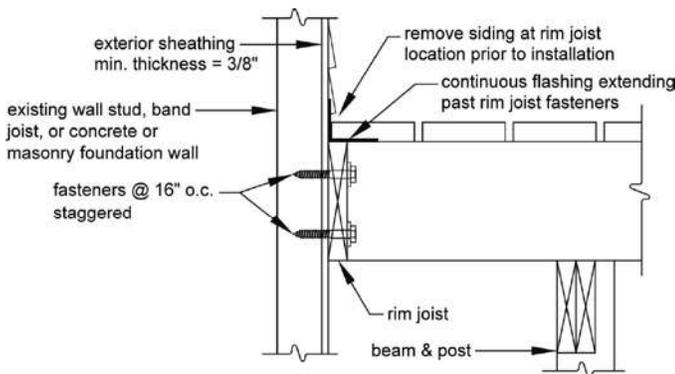
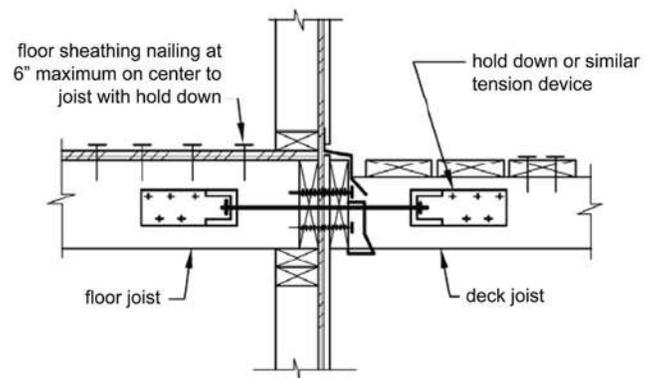


Figure 23A. Example of a Lateral Load Device for a Deck Attached to a House with a Ledger

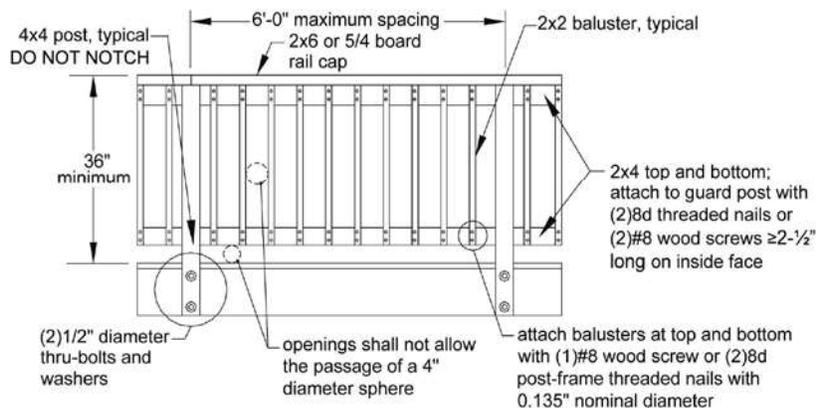


GUARD REQUIREMENTS

All decks greater than 30" above grade are required to have a guard [R312.1] - one example is shown in Figure

24. Other methods and materials may be used for guard construction when approved by the authority having jurisdiction.

Figure 24. Example Guard Detail



GUARD POST ATTACHMENTS

Deck guard posts shall be a minimum 4x4 (nominal) with an adjusted bending design value not less than 1,100 psi.

Guard posts for guards which run parallel to the deck joists shall be attached to the outside joist per Figure 25. Guard posts for guards that run perpendicular to the deck

joists shall be attached to the rim joist in accordance with Figure 26. Only hold down anchor models meeting these minimum requirements shall be used. Hold down anchors shall have a minimum allowable tension load of 1,800 pounds for a 36" maximum rail height and be installed in accordance with the manufacturer's instructions.

Figure 25. Guard Post to Outside Joist Example

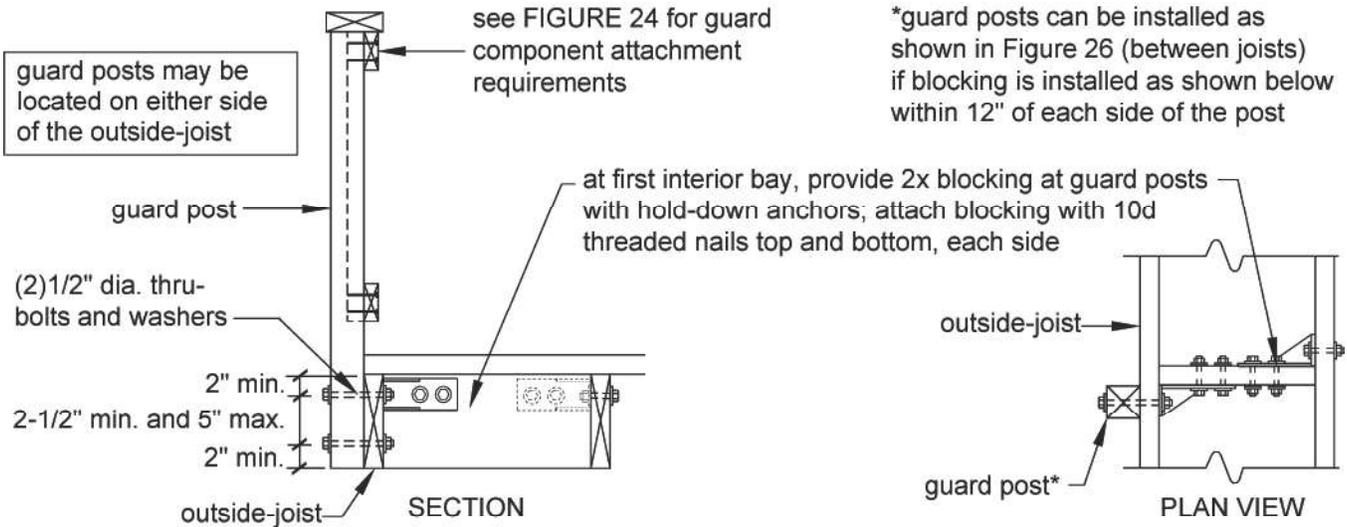
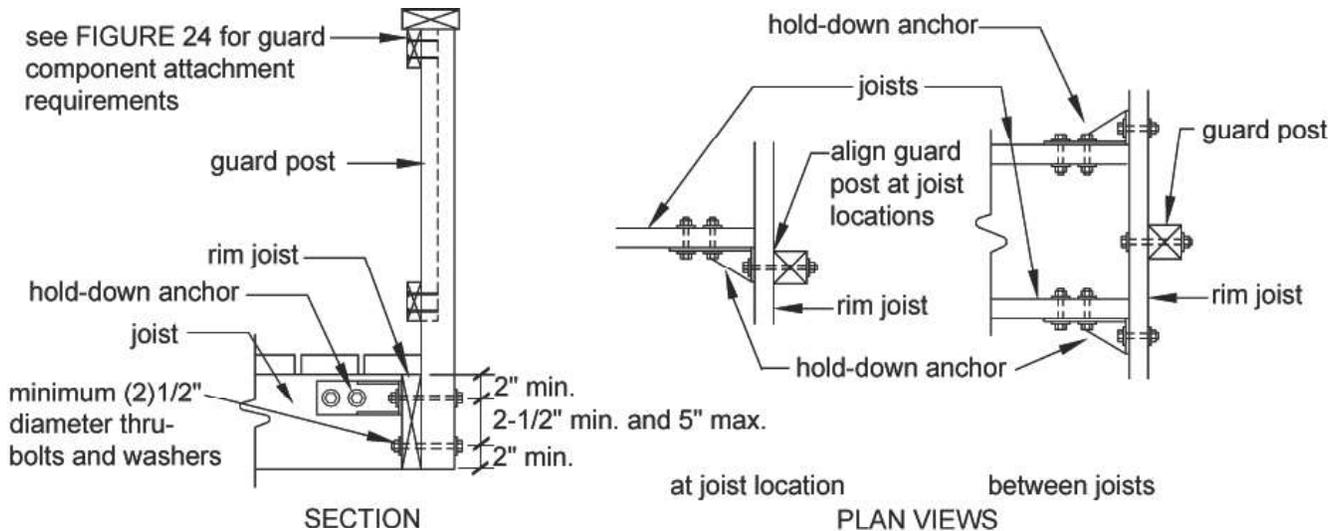


Figure 26. Guard Post to Rim Joist Example



STAIR REQUIREMENTS

Stairs, stair stringers, and stair guards shall meet the requirements shown in Figure 27 through Figure 34 and Table 6 except where amended by the local jurisdiction. All stringers shall be a minimum of 2x12. Stair stringers shall not span more than the dimensions shown in Figure 28. If the stringer span exceeds these dimensions, then a 4x4 post may be provided to support the stringer and shorten its span length. The 4x4 post shall be notched and bolted to the stringer with (2) 1/2" diameter through-bolts with washers per Figure 8. The post shall be centered on a 12" diameter or 10" square, 6" thick footing. The footing shall be constructed as shown in Figure 34 and attached to the post as shown in Figure 12. An intermediate landing may also be provided to shorten

the stringer span (see provisions below). If the total vertical height of a stairway exceeds 12'-0", then an intermediate landing shall be required. All intermediate stair landings must be designed and constructed as a free-standing deck using the details in this document. Stairs shall be a minimum of 36" in width as shown in Figure 33 [R311.7]. If only cut stringers are used, a minimum of three are required. For stairs greater than 36" in width, a combination of cut and solid stringers can be used, but shall be placed at a maximum spacing of 18" on center (see Figure 29). The width of each landing shall not be less than the width of the stairway served. Every landing shall have a minimum dimension of 36" measured in the direction of travel and no less than the width of the stairway served [R311.7].

Figure 27. Tread and Riser Detail

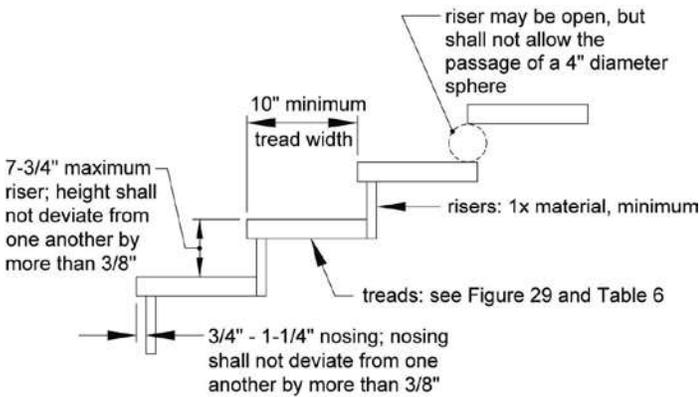


Figure 28. Stair Stringer Requirements

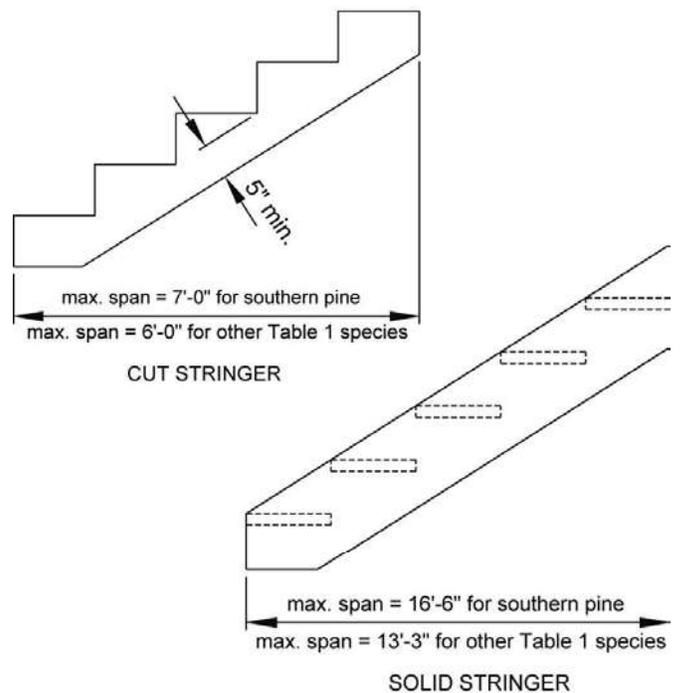


Figure 29. Tread Connection Requirements

Attachment per tread at each stringer or ledger:
 2x_ or 5/4 treads - (2)8d threaded nails or (2)#8 screws ≥2-1/2" long
 3x_ treads - (2)16d threaded nails or (2)#8 screws ≥3-1/2" long

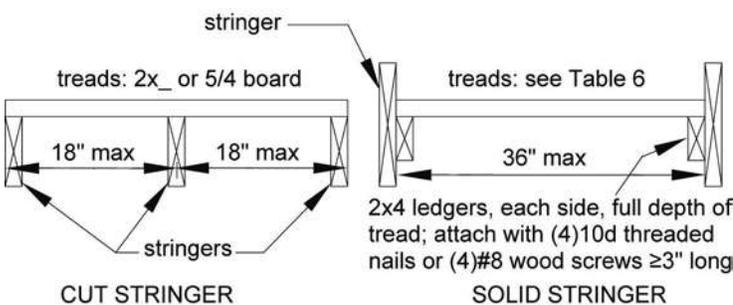


Table 6. Minimum Tread Size for Cut and Solid Stringers¹

Species	Cut Stringer	Solid Stringer
Southern Pine	2x4 or 5/4	2x6
Douglas Fir Larch, Hem-Fir, SPF ²	2x4 or 5/4	2x8 or 3x4
Redwood, Western Cedars, Ponderosa Pine ³ , Red Pine ³	2x4 or 5/4	2x10 or 3x4

1. Assumes 300 lb concentrated load, L/288 deflection limit, No. 2 grade, and wet service conditions.
 2. Incising assumed for refractory species including Douglas fir-larch, hem-fir, and spruce-pine-fir.
 3. Design values based on northern species with no incising assumed.

Figure 30. Stair Guard Requirements

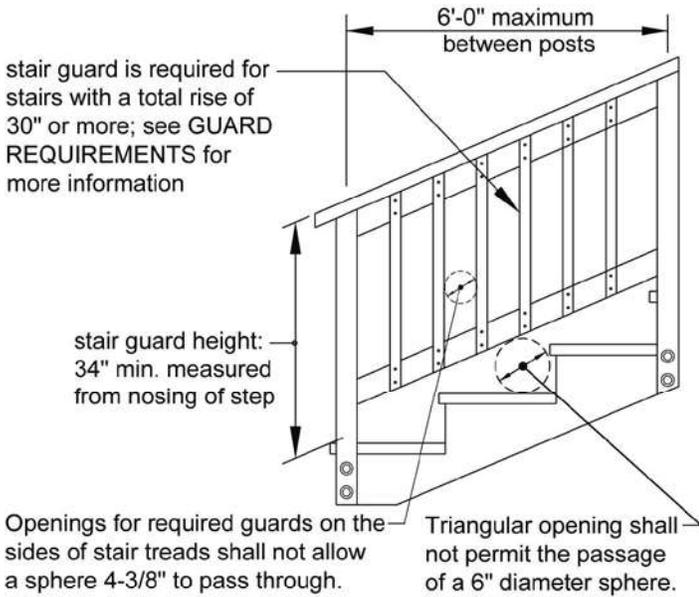
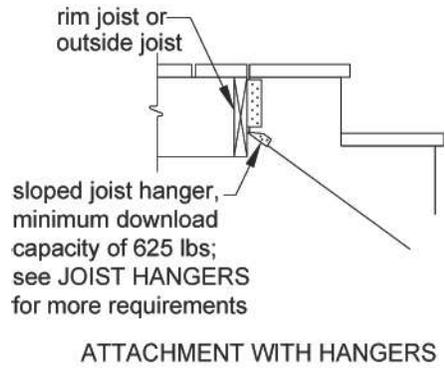


Figure 31. Stair Stringer Attachment Detail



STAIR HANDRAIL REQUIREMENTS

All stairs with 4 or more risers shall have a handrail on at least one side (see Figure 32A) [R311.7.7]. The handrail height measured vertically from the sloped plane adjoining the tread nosing shall be not less than 34 inches and not more than 38 inches (see Figure 30) [R311.7.7.1]. Handrails shall be graspable and shall be composed of decay-resistant and/or corrosion resistant material. Handrails shall be Type I, Type II, or provide equivalent graspability (see Figure 32B). Type I shall have a perimeter dimension of at least 4" and not greater

than 6-1/4". Type II rails with a perimeter greater than 6-1/4" shall provide a graspable finger recess area on both sides of the profile [R311.7.7.3]. All shapes shall have a smooth surface with no sharp corners. Handrails shall run continuously from a point directly over the lowest riser to a point directly over the highest riser and shall return to the guard at each end (see Figure 33). Handrails may be interrupted by guard posts at a turn in the stair [R311.7.7.2].

Figure 32A. Handrail Mounting Examples

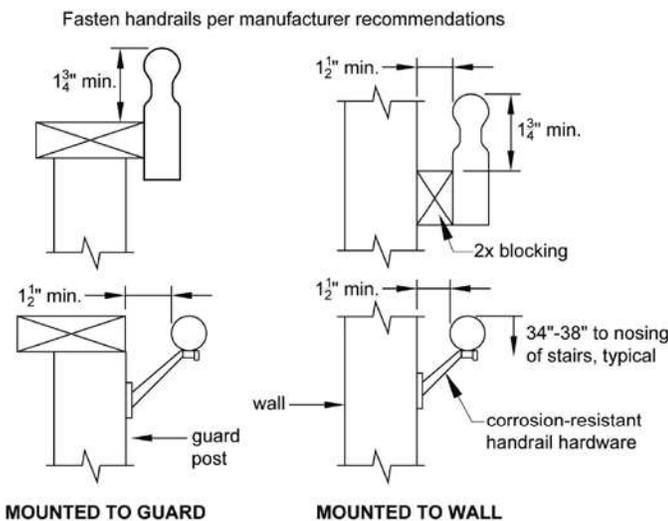
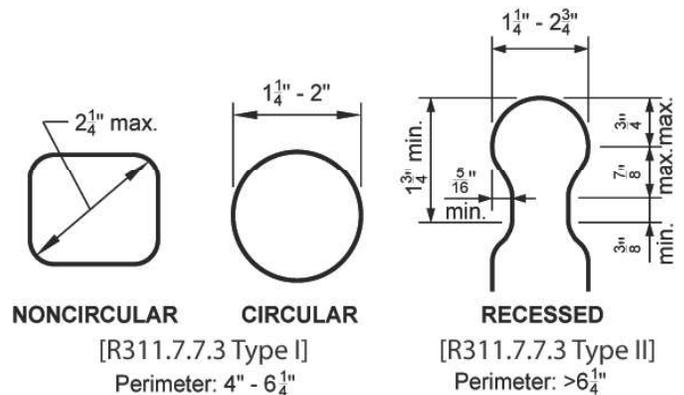


Figure 32B. Handrail Grip Size



STAIR FOOTING REQUIREMENTS [R403]

Where the stairway meets grade, attach the stringers to the stair guard posts as shown in Figure 34. Posts shall bear on footings. All footings shall bear on solid ground and shall be placed at least 12 inches below the undisturbed ground surface or below the frost line, whichever is deeper (see Figure 34). Stringers shall bear on a 2x4 bearing block attached to the post as shown. Stringers shall not bear on new or existing concrete pads or patios that are not founded below this depth. When guards are not required (see GUARD

REQUIREMENTS), posts may terminate below the bottom tread elevation. Bolts are only required if a guard post is required.

STAIR LIGHTING REQUIREMENTS [R303.6]

Stairways shall have a light source located at the top landing such that all stairs and landings are illuminated. The light switch shall be operated from inside the house. However, motion detected or timed switches are acceptable.

Figure 33. Miscellaneous Stair Requirements

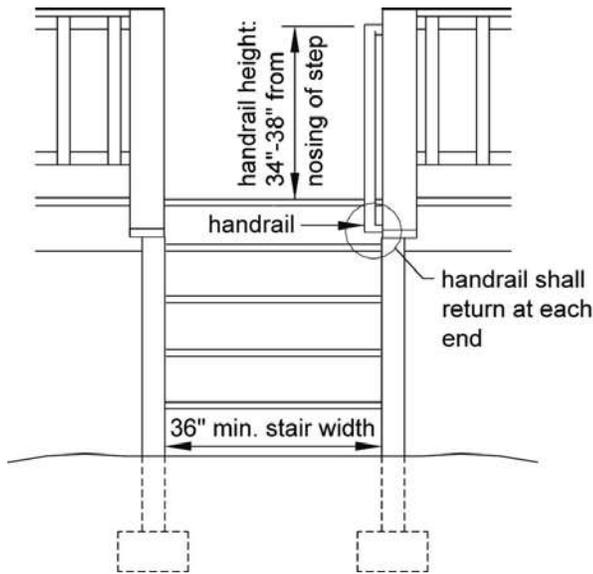
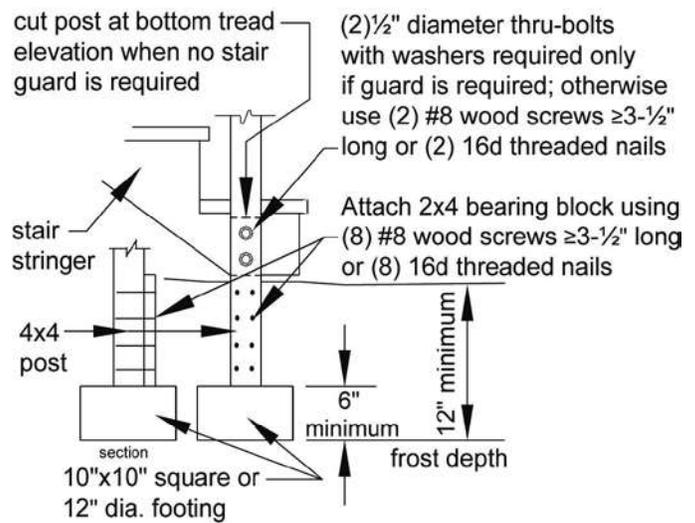


Figure 34. Stair Footing Detail



FRAMING AT CHIMNEY OR BAY WINDOW

All members at a chimney or bay window shall be framed in accordance with Figure 35. Headers may span a maximum of 6'-0". When a chimney or bay window is wider than 6'-0", one or more 6x6 posts may be added to reduce header spans to less than 6'-0". In such cases, the post footing must meet the requirements in the FOOTINGS section. Headers with a span length greater than 6'-0" require a plan submission. Headers shall be located no more than 3'-0" from the end of the trimmer joist.

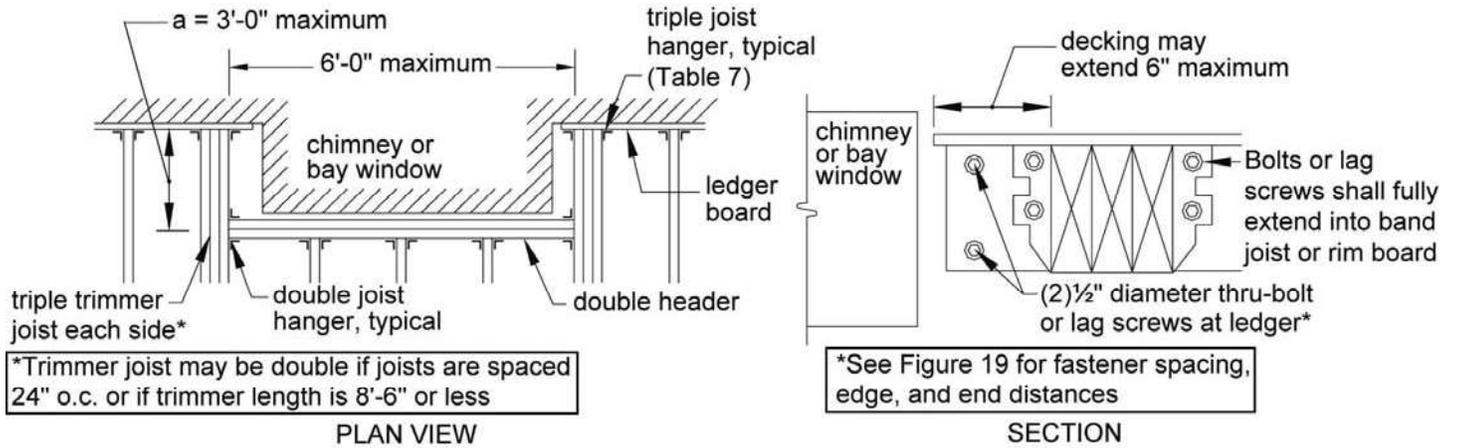
1B. Joist hangers shall each have a minimum download capacity in accordance with Table 7. Bolts or lag screws used to attach the hanger to the ledger shall fully extend through the ledger into the 2-inch nominal lumber band joist (1-1/2" actual) or EWP rim board. Otherwise a freestanding deck is required.

Table 7. Trimmer Joist Hanger Download Capacity

Joist Size	Minimum Capacity, lbs
2x8	1050
2x10	1380
2x12	1500

Triple trimmer joists are required on each side of the header if joist spacing is 12" or 16" o.c. or if the trimmer joist span exceeds 8'-6"; otherwise, double trimmer joists are permitted. Trimmer joists may bear on the beam and extend past the beam centerline up to L_v/4 as shown in Figures 1A and 2, or the trimmer joist may attach to the side of the beam with joist hangers as shown in Figure

Figure 35: Detail for Framing Around a Chimney or Bay Window



**American
Wood
Council**



Traditional and Engineered Wood Products

It is intended that this document be used in conjunction with competent design, accurate fabrication, and adequate supervision of construction. While every effort has been made to insure the accuracy of the information presented, the American Forest & Paper Association and its members do not assume responsibility for errors or omissions in the document, nor for designs, plans, or construction prepared from it. Those using this document assume all liability arising from its use.

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Commentary to Prescriptive Residential Wood Deck Construction Guide DCA 6



Foreword

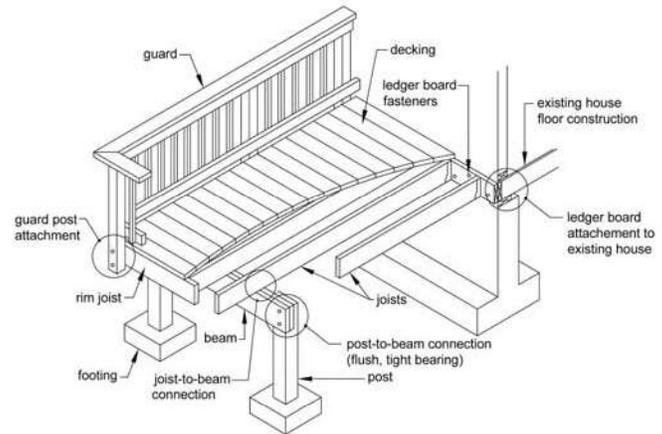
This *Commentary to DCA 6 – Prescriptive Residential Wood Deck Construction Guide* has been requested by builders, building officials, and others, to provide background information and example calculations for various sections and tables of *DCA 6*.

The *DCA 6 Commentary* follows the same organization as *DCA 6*. Discussion of a particular provision in *DCA 6* is found in the *DCA 6 Commentary* by locating the same section or subsection found in *DCA 6*. Not every section of *DCA 6* has a corresponding commentary section. The *DCA 6 Commentary* provides background information intended to give the reader an understanding of the data and/or experience upon which the provision is based. One or more examples of the calculation procedures used to produce several of the tables are given to illustrate the scope of conditions covered by the table.

The provisions of *DCA 6* come primarily from the International Code Council's *International Residential Code (IRC)*. In developing the *DCA 6 Commentary*, data available from laboratory tests and experience with structures in-service was analyzed and evaluated for the purpose of providing a consistent explanation. It is intended that this document be used in conjunction with competent design, accurate fabrication, and adequate supervision of construction. Therefore, AF&PA does not assume any responsibility for errors or omissions in the *DCA 6 Commentary*, nor for designs or plans prepared from it.

Inquiries, comments, and suggestions from readers of this document are invited.

American Forest & Paper Association



Background

In August 2006, the American Forest & Paper Association's American Wood Council (AWC) Technical Committee formed an ad-hoc task group to address prescriptive provisions for residential wood deck construction. Representatives of the wood products industry, home builders, connector manufacturers, building officials, and truss industry were represented on the task group.

The Technical Committee urged the Task Group not to "reinvent the wheel," but to review existing information to determine if there was something on which to build. One resource reviewed was a document developed by the Fairfax County, Virginia Department of Public Works and Environmental Services titled "Typical Deck Details." With Fairfax County's permission, this became the basis for *DCA 6*.

Since Fairfax County's *Typical Deck Details* was developed for a specific geographic location, *DCA 6* was expanded to apply on a national basis (e.g. addition of western lumber species). The first version of *DCA 6* was posted to the AWC website in October 2007.

Basis

As stated in the boxed text on the cover of *DCA 6*, provisions and details are based on the International Code Council's (ICC) *International Residential Code (IRC)*. The original version of *DCA 6* was based on the *2006 IRC*. Subsequent versions of *DCA 6* incorporated changes based on published supplements (approved code changes) to the *IRC*. The current version of *DCA 6* is based on the *2009 IRC*.

Alternative Methods and Materials

A key point for users is the statement: "This document is not intended to preclude the use of alternative methods and materials." Further, *IRC* R104.11 states: "An alternative material, design or method of construction

shall be approved where the building official finds that the proposed design is satisfactory and complies with the intent of the provisions of this code, and that the material, method or work offered is, for the purpose intended, at least the equivalent of that prescribed in this code." While AWC develops design tools and guidelines for wood construction, it is recognized that decks are built with materials other than wood. Many of these materials undergo scrutiny through a code evaluation process such as that promulgated by ICC's Evaluation Services. The result is typically an Evaluation Service Report (ESR) for the product. The building official is typically the authority having jurisdiction and makes the final decision regarding all construction methods and materials.

MINIMUM REQUIREMENTS

1. This document applies to single level residential wood decks only. Multiple level decks will likely have stairs that create additional concentrated loads that are not considered in the joist and beam span tables for *DCA 6*. Non-residential decks or balconies typically require design by a licensed professional.

2. Table 1 does not provide an exhaustive list of preservative treatments and retention levels for ground contact lumber. The American Wood Protection Association (AWPA) is a non-profit organization which is responsible for promulgating voluntary wood preservation standards. AWPA Standards are developed by its technical committees under an ANSI accredited consensus-based process. Note also that many preservative treatments undergo scrutiny through a code evaluation process such as that promulgated by ICC's Evaluation Services. The result is typically an Evaluation Service Report (ESR) for the product.

3. Smooth shank nails are prone to "backing out" of wood due to moisture cycling. Threaded nails include helical (spiral) and annular (ring-shank) nails as defined in *ASTM F 547*. Including the common terms "spiral" and "ring-shank" is important to ensure availability from lumber yards. Reference design values for post frame ring shank nails in accordance with *ASTM F1667* are provided in [DA4: Post Frame Ring Shank Nails](#) (AF&PA 2007). Tabulated values are calculated in accordance with the *2005 National Design Specification*[®] (*NDS*[®]) for Wood Construction yield limit equations.

4. *NDS* Chapter 11 contains spacing, end, and edge distance requirements for various fasteners, including bolts and lag screws.

5. When subjected to standardized laboratory tests that accelerate the corrosion process, metal connectors and fasteners exposed to the chemicals used in ACQ, Copper Azole, or ACZA exhibit higher rates of corrosion than connectors and fasteners exposed to CCA. Users should rigorously apply recommendations of the chemical manufacturers and the treating industry – to use corrosion resistant fasteners and connectors or zinc coated (galvanized) fasteners and connectors with corrosion protection at least equivalent to that of hot-dip galvanized products. Additional information is available from various sources including:
<http://www.awc.org/HelpOutreach/faq/Corrosion.html>

6. Concentrated loads, such as those created by hot tubs and planters, are beyond the scope of *DCA 6*.

7. Structural members and connections shown in *DCA 6* have been sized based primarily on a uniformly distributed floor live load of 40 psf and a dead load of 10 psf (table footnotes specify where other point loads have been considered). If a deck is not prone to sliding or drifting snow, the criteria in *DCA 6* can be conservatively applied to a deck with a uniformly distributed snow load of 40 psf and a 10 psf dead load.

The *IRC* provides guidance on applicability of provisions of the *IRC* for high wind and seismic regions as follows:

“**R301.2.1.1 Design criteria.** Construction in regions where the basic wind speeds from Figure R301.2(4) equal or exceed 100 miles per hour in hurricane-prone regions, or 110 miles per hour elsewhere, shall be designed in accordance with one of the following:...” Several alternate methodologies are subsequently listed. This indicates that provisions of the *IRC* are applicable in hurricane regions less than 100 mph and less than 110 mph elsewhere.

“**R301.2.2 Seismic provisions.** The seismic provisions of this code shall apply to buildings constructed in Seismic Design Categories C, D₀, D₁ and D₂, as determined in accordance with this section...”

Exception: Detached one- and two-family dwellings located in Seismic Design Category C are exempt from the seismic requirements of this code.”

8. *IRC* R703.8(5) requires attachment of flashing “...Where exterior porches, decks, or stairs attach to a wall or floor assembly of wood-frame construction.” Aluminum flashing should not be used if it will be in contact with treated lumber. Lumber treated with preservatives such as alkaline copper quat (ACQ), copper azole (CA), or ammoniacal copper zinc arsenate (ACZA) all contain copper. As a result, they will corrode aluminum flashing as well as ferrous metals.

9. *IRC* R110.1 Use and occupancy states: “No building or structure shall be used or occupied...until the building official has issued a certificate of occupancy...”

10. See Commentary for **Alternative Methods and Materials**.

DECKING REQUIREMENTS

The American Lumber Standard Committee (ALSC) *Policy for Evaluation of Recommended Spans for Span Rated Decking Products* (ALSC Decking Policy) provides a uniform method for assessing span rated decking products which are produced from many different species of wood, and graded under several different grading standards. This ALSC policy covers specific products classified by size as decking and are assigned a recommended span of usually 16" or 24". This policy is not intended to be used for the assessment or approval of decking spans in excess of 24". The range of current grading rule specifications and species requires the establishment of a uniform common analytical procedure for assessing the appropriateness of these products relative to the recommended spans. This ALSC policy establishes this uniform analytical procedure.

The analysis for maximum span rating assumes the following design conditions:

1. Span – Two-span continuous with load applied to only one span.
2. Seasoning – Green use condition (Moisture Content >19%), assumed to be 23% MC or greater.

3. Deflection Limit – Deflection under design loads using calculated average allowable modulus of elasticity shall not exceed L/180.

Load Conditions – Allowable span analysis includes the following two load conditions with load applied on one span of a two-span continuous beam:

- a. Uniform Load – the calculated maximum allowable fiber stress in bending derived from *ASTM D2555* and *D245*, or the In-grade test procedures of Annex 1 (of ALSC Decking Policy) equals or exceeds the stress induced by a 70 psf uniform load on the recommended span. The analysis assumes normal load duration.
- b. Point Load – the calculated maximum allowable fiber stress in bending derived from *ASTM D2555* and *D245*, or the In-grade test procedures of Annex 1 (of ALSC Decking Policy) equals or exceeds the stress induced by a 220 lb. point load applied at the midpoint of the recommended span. The analysis assumes 7-day load duration.

See Commentary for **Alternative Methods and Materials** for decking materials not covered by the ALSC policy

JOIST SIZE

Joist spans are based on lumber size and joist spacing. The span of a joist is measured from the centerline of bearing at one end of the joist to the centerline of bearing at the other end of the joist and does not include the length of the overhangs. Joist spans are limited to a maximum of 18'-0" to ensure appropriate design of beams and footings. If longer joist spans are designed, joist hangers, beams, posts, and footings will have to be analyzed to ensure appropriate load path. See span calculator at www.awc.org for simple span conditions without overhangs, however spans shall not exceed 18'-0" when used in conjunction with *DCA 6*.

For simple span applications without overhangs and uniformly distributed loads, maximum joist spans are as shown in Table 2. Span calculations in Table 2 assume a 40 psf live load, 10 psf dead load, L/360 deflection limit, No. 2 grade, and wet service conditions.

Span calculations in Table 2 for joists with overhangs (cantilevers), in addition to the 40 psf live load and 10 psf dead load, assume L/180 cantilever deflection with a 220 lb point load (same as used for span rated decking), No. 2 grade, and wet service conditions. The 220 pound point load controlled in certain cases such as 2x8 and 2x10 at 12" and 16" o.c. – which is why the spans are the same (see Table C2). Deflection controlled for almost all 12" o.c. spacings and most 16" o.c. spacings.

Joist spans can extend (overhang) past the joist bearing centerline up to $L_j/4$ as shown in Figure 1A and Figure 2, or the joists may attach to the side of the beam with joist hangers as shown in Figure 1B (however, joists shall not

be attached to opposite sides of the same beam). Allowing joists to span from opposite sides of the beam without appropriate consideration could potentially lead to a condition where beam capacity is exceeded.

Incising factors are used for refractory species including Douglas fir-larch, hem-fir, and spruce-pine-fir. Hem-fir spans control for these three species combinations. Northern species design values are used for Ponderosa pine and red pine with no incising assumed. These species are combined with redwood and western cedar since incising is not necessary for naturally durable wood (heartwood of the following species: decay-resistant redwood and cedars - corner sapwood is permitted if 90 percent or more of the width of each side on which it occurs is heartwood), therefore design values are comparable. Northern species design values control spans for these four species combinations.

Table C2. Areas Where Point Load Controls Maximum Joist Spans with Overhangs*.

Species	Size	With Overhangs up to $L_j/4^2$		
		12"	16"	24"
Southern Pine	2x8	10' - 9"	10' - 9"	10' - 2"
	2x10	15' - 6"	15' - 6"	13' - 1"
	2x12	18' - 0"	18' - 0"	15' - 5"
Douglas Fir-Larch, Hem-Fir, SPF ³	2x8	9' - 5"	9' - 5"	10' - 1"
	2x10	13' - 7"	13' - 7"	11' - 1"
	2x12	18' - 0"	15' - 9"	12' - 10"
Redwood, Western Cedars, Ponderosa Pine ⁴ , Red Pine ⁴	2x8	8' - 6"	8' - 6"	8' - 6"
	2x10	12' - 3"	12' - 3"	10' - 7"
	2x12	16' - 5"	15' - 1"	12' - 4"

220 lb point load controls

*See Table 2 for footnotes.

BEAM SIZE & ASSEMBLY REQUIREMENTS

Deck beam spans are in accordance with Table 3 and can extend past the post centerline up to $L_B/4$ as shown in Figure 3. Beams are sized based on tributary load from joists within the span limits shown in Table 2. Joists are assumed to span from one side only. Allowing joists to span from opposite sides of the beam without appropriate consideration could potentially lead to a condition where beam capacity is exceeded.

With appropriate assumptions, Table 3 could be used to size beams with joists spanning from both sides. Since tabulated values for beams assume $1/2$ of the joist span to calculate tributary area, using 2x the joist span for cases

where joists span symmetrically (equal joist spans) from opposite sides is acceptable. For example, assume there are 8'-0" joists spanning from opposite sides of the same beam. The column in Table 3 labeled for 16'-0" joist spans can be used to size a beam in this case.

Refractory species and naturally durable species are combined because of the incising factor. Even though design values for naturally durable species are lower than those of the refractory species, the incising factors applied to strength and stiffness values of refractory species offset the differences. Therefore, span differences are minimal. Northern species design values control spans for these species combinations.

DECK FRAMING PLAN

A framing plan shows the layout of the primary structural system. Examples of structural elements include: joists, beams, ledger board, posts, footings, stringers, treads, and the type, size, and spacing of ledger board fasteners. Figure C5 shows an example of a typical deck framing plan.

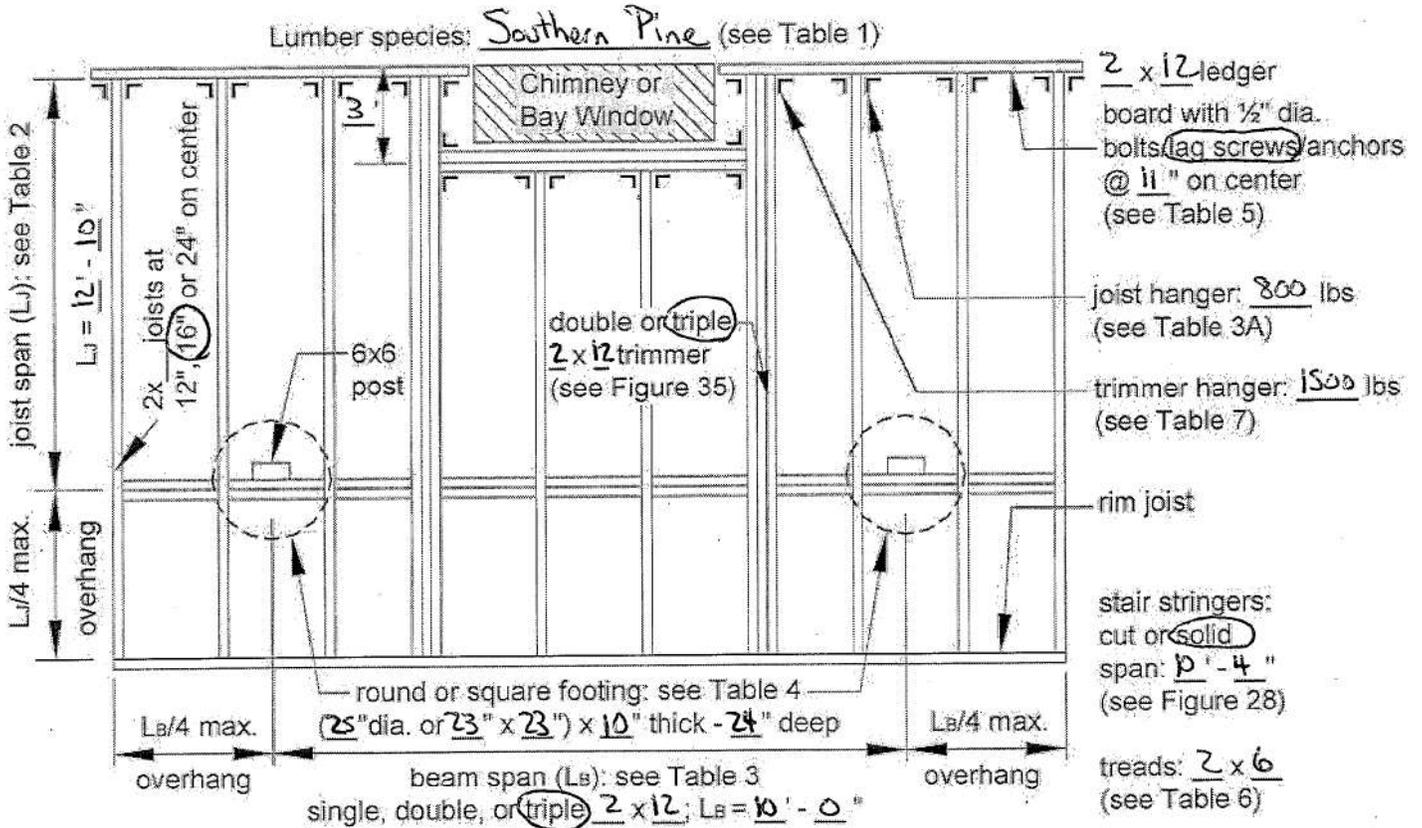


Figure C5. Example of Typical Deck Framing Plan

JOIST-TO-BEAM CONNECTION

Joist-to-beam connections must be installed to handle forces in several directions. Options 1 and 2 handle gravity loads through bearing of the joist to the beam, while Option 3 requires nails to resist these downward loads. All three options have been evaluated to ensure

that an uplift load created by a 220 lb point load at the end of a cantilevered joist will be resisted.

Manufacturers regard connectors with missing nails as mis-installations and do not recommend they be installed as such.

JOIST HANGERS

The loads listed in the Table 3A are derived from the worst case condition for each joist size based on Table 2 (508 lbs, 654 lbs, and 771 lbs for southern pine at 24" o.c. for 2x8, 2x10, and 2x12, respectively). For simple

span applications without overhangs, as shown in Table 2, note that spans are identical to those shown in Table 2 with overhangs for southern pine joists at 24" o.c., therefore the same joist hanger capacities as shown in Table 3A will work for spans with or without overhangs.

POST REQUIREMENTS

IRC section R407.3 specifies a minimum 4x4 (nominal) wood column size. Requiring a minimum 6x6 post in DCA 6 is conservative for most deck applications. Further, this simplification allows a deck height of up to 14' and provides adequate bearing for beams. Note that notching of the post to accommodate a nominal 3x, 4x, or 2-ply 2x beam exceeds limits for bending members, so for lateral load conditions, the post would need to be designed per the *National Design Specification® (NDS®) for Wood Construction*.

Prohibiting attachment of the beam to the sides of the post with fasteners only (Figure 9) ensures wood-to-wood bearing and avoids potential issues that could arise from using inappropriate (non-corrosion resistant) fasteners.

For 3-ply 2x beams, a post cap is required since the remaining cross section at the post notch would not be sufficient to provide adequate connection of the beam to the column. The connector shown in Figure 10 is readily available with extra corrosion protection and offers uplift and lateral load resistance.

Provisions for **Alternative Methods and Materials** allow for other post sizes and post-to-beam connections if approved by the building official. For example, in order to use a 4x4 post, it would require the use of a post

cap connection as shown in Figure 10. There is not enough cross sectional area in a 4x4 to permit the let-in notch detail as shown in Figure 8. Connector hardware for a 4x4 post is generally limited to 2-ply nominal 2 inch beams or 4 inch nominal beams. Certain post caps may be adjusted to fit a 3-ply 2 inch nominal member onto a 4x4 post, but must be special ordered and manufactured manually. Contact a connector manufacturer to determine if there are solutions for connecting a single 3x nominal member onto a 4x4 post.

Assuming that identical species will be used for joists and beams, an analysis of Table 3 reveals that a maximum tributary area of approximately 81 ft² will result if southern pine is used (see calculations under FOOTINGS for L_J = 18'-0" and L_B = 8'-0" for 2-2x12). This results in a load on the post of 4,061 lbs. A 4x4 southern pine No. 2 post 10' in height would work in this situation (assuming pinned end fixity). Similarly, for other Table 3 species, assuming joists and beams are the same species, a maximum post load of 3,717 lbs is calculated. A 4x4 No. 2 post 8' in height will work in this case (western cedar controls). If different species are used for joists than are used for beams, an analysis is required to determine the maximum tributary area on the post.

FOOTINGS

Footing sizes are based on the assumptions of 1,500 psf soil bearing capacity and 2,500 psi compressive strength of concrete which are the minimum values based on IRC Tables R401.4.1 and R402.2. The following equations are used to size footings (see Figure C12):

$$\text{Post load (lbs): } R = 50 \left(\frac{L_J}{2} + \frac{L_J}{4} \right) \left(\frac{L_B}{2} + \frac{L_B}{4} \right)$$

where: L_J and L_B units are in feet.

$$\text{Square footing (in.): } B = 12 \sqrt{\frac{R}{1500}}$$

$$\text{Round footing (in.): } D = 12 \sqrt{\frac{4R}{1500\pi}}$$

$$\text{Footing thickness (in.): } T \geq P; T \geq \frac{D - 5.5}{2}$$

Figure C12. Footing dimensions and variables

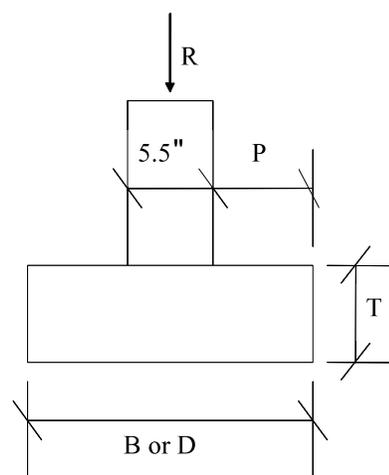


Table C4 shows additional footing diameters and thicknesses for joist spans not shown in Table 4.

Coordinating the footing thickness with post base and anchor requirements means ensuring that post anchor length does not exceed the thickness of the footing.

Table C4. Footing Sizes¹

Beam Span L _B	Joist Span L _J	Round Footing Diameter	Square Footing Dimension	Footing Thickness ²
6'	<8'	13"	11"	6"
	<12'	16"	14"	6"
	<16'	19"	17"	7"
8'	<8'	15"	13"	6"
	<12'	19"	17"	7"
	<16'	21"	19"	8"
10'	<8'	17"	15"	6"
	<12'	21"	19"	8"
	<16'	24"	22"	9"
12'	<8'	19"	17"	7"
	<12'	23"	21"	9"
	<16'	26"	24"	11"
14'	<8'	20"	18"	8"
	<12'	24"	22"	10"
	<16'	28"	26"	12"
16'	<8'	21"	19"	8"
	<12'	26"	24"	11"
	<16'	30"	28"	13"
18'	<8'	23"	21"	9"
	<12'	28"	26"	11"
	<16'	32"	30"	13"

1. Assumes 1,500 psf soil bearing capacity.
2. Assumes 2,500 psi compressive strength of concrete. Coordinate footing thickness with post base and anchor requirements.

LEDGER ATTACHMENT REQUIREMENTS

According to IRC R311.3.1, the distance from the top of the threshold to the top of deck boards cannot exceed 1-½". If a door does not swing over the landing or deck, the step-down can be up to 7-¾". The ledger can be lowered for improved drainage, subject to meeting maximum step-down heights for accessibility and means of egress, edge distance and spacing requirements, and shear design at connection requirements of NDS 3.4.3.3(a).

The basis for edge distances and spacing between rows (Figure 19) is NDS Tables 11.5.1A and 11.5.1D, respectively, for perpendicular to grain conditions. Per NDS Table 11.5.1A, edge distance is 4D (where D is fastener diameter) for the loaded edge. For ½" diameter bolts, 4D = 2" edge distance.

Per NDS Table 11.5.1D, spacing between rows is based on the l/d ratio of the fastener. For a 1-½" ledger and rim board, $l/d = 1\text{-}1/2" / 1/2" = 3$ and the minimum spacing is $(5l + 10D) / 8 = 1\text{-}9/16"$ – this is rounded up to 1-⁵/₈". Per footnote 2 of NDS Table 11.5.1D, the maximum spacing between fasteners is 5". This requirement is based on potential shrinkage of the ledger which could create tension perpendicular to grain stresses if the outer edges of the ledger are constrained by bolts.

The requirement for minimum distance between the top of the ledger and the bottom row of fasteners (Figure 19) is based on NDS 3.4.3.3(a) for shear design at connections. When the connection is less than five times the depth, 5d, of the bending member from its end, the adjusted design shear is calculated as follows:

$$V_r' = \left[\frac{2}{3} F_v' b d_e \right] \left[\frac{d_e}{d} \right]^2$$

Solving for d_e yields the following:

$$d_e^3 = 3 V_r d^2 / (2 F_v' b)$$

Assuming a hem-fir No. 2 ledger, the reference horizontal shear design value, $F_v = 150$ psi. The adjusted shear design value, F_v' , is based on a wet service factor, $C_M = 0.97$, and incising factor, $C_i = 0.80$. The maximum allowable lateral design value of 725 lbs for 1/2" bolts and 385 lbs for 1/2" lag screws - is based on testing at Virginia Tech and Washington State University (Carradine et al., 2006). Spacing calculations assume that bolts or lag screws at the end of the ledger have half the tributary area of interior bolts or lag screws and that the shear at interior bolts or lag screws is half of the interior bolt or lag screw reaction. Therefore, the minimum value of d_e is calculated assuming V_r equals one-half of the allowable lateral design value for the 1/2" bolts (725/2 lbs) or 1/2" lag screws (385/2 lbs). Resulting values of d_e are as follows:

	<u>1/2" bolts</u>	<u>1/2" lags</u>
2x8	$d_e = 5.47"$	$d_e = 4.43"$
2x10	$d_e = 6.43"$	$d_e = 5.21"$
2x12	$d_e = 7.33"$	$d_e = 5.9"$

The problem with these effective depths is that a 2x8 ledger connected to a 2x8 band joist with bolts will not work (see Figure C19).

Possible solutions for the 2x8 band joist include:

Table C5. Revised Bolt Spacing Requirements for 2x8 Ledgers to 2x8 Band Joists.

	Joist Span			
	6'-0" & less	6'-1" to 8'-0"	8'-1" to 10'-0"	10'-1" to 12'-0"
1/2" bolt	32"	24"	19"	16"
1/2" bolt with 1/2" stacked washers	27"	20"	16"	13"

- 1) Free standing deck.
- 2) Step-down the deck 7-3/4" from the threshold per IRC requirements and connect to the wall below. Note that this solution is prohibited if the wall is for a walk-out basement.
- 3) Require lag screws for 2x8 band joist and revise required $d_e = 4.5"$ as shown in Figure 19.
- 4) Allow bolted connections for 2x8 band joist if bolt spacing is reduced to the same as that for lag screws (only applies to 1/2" bolts without stacked washers as shown in Table C5) as shown in Figure 19.
- 5) Reduce bolt spacing requirements for 2x8 ledger to 2x8 band joist. When $d_e = 4.5"$, $V_r = 202$ lbs, and the back-calculated adjustment factor is 0.56. Based on Table 2, the maximum joist span for a 2x8 is 10'-6". This results in revised spacing for 1/2" bolts as shown in Table C5.

Continuous flashing is required as shown in Figure 14 to prevent water intrusion behind the ledger. One alternative to this detail would be continuous flashing with a drip edge, however, this would be labor intensive because the flashing would require notching at every deck joist location.

Connection of ledgers to empty hollow masonry cell blocks (Figure 16) of existing construction is generally not practical because most manufacturers of concrete block anchors do not published allowable shear values for a ledger connected to a hollow masonry block of unknown compression strength and wall thickness at the point of attachment. Due to the uncertainty and lack of test data for this application, a free standing deck is recommended (see Figures 21 and 22).

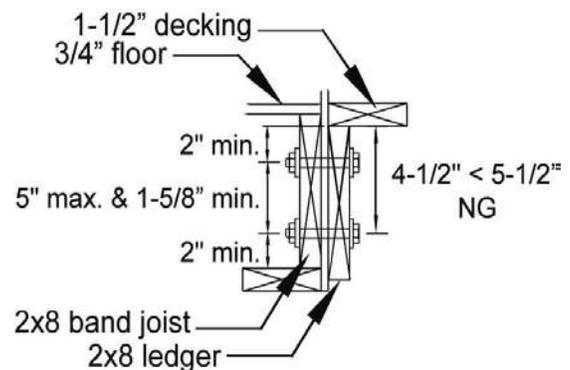


Figure C19. Edge Distance and Spacing Requirements for 2x8 Band Joist and 2x8 Ledger.

DECK STABILITY

The requirement for diagonal bracing when a deck is greater than 2 feet above grade is applicable to both free-standing decks and decks supported by a ledger.

If the deck is attached to the house as shown in Figures 14, 15, 16, or 23, an alternative to knee braces for deck stability (Figure 22) is installation of decking at a 45 degree angle to the deck joists. Decks are stiffer laterally with diagonally oriented lumber decking versus decking installed perpendicular to joists.

With respect to hold down tension devices, *IRC* R502.2.2 requires anchorage to the primary structure for both vertical and lateral loads as applicable. Further, the *IRC* includes hold down tension devices as a prescriptive means to achieve compliance with the lateral load connection requirements without requiring engineering. Figure 23A was taken directly from the FEMA *Home Builder's Guide to Seismic Resistant Construction*

(FEMA 232) which refers to it as an “above-code recommendation.” In lieu of the prescriptive hold down tension device specified, an alternate engineered connection detail is permitted or the deck can be designed to be free-standing.

While Item 7 of *DCA 6* Minimum Requirements states that the document does not address wind or seismic design issues, some interpret R502.2.2 to be applicable in all cases since lateral loads can be developed by other sources including people moving or dancing on a deck. Another interpretation is that the term “as applicable” in R502.2.2 means the provision is only required for code prescribed loads. The only code prescribed lateral loads are wind and seismic.

Where deck joists are perpendicular to the house floor joists, blocking between house joists and boundary nailing of the house floor diaphragm to the blocking is required.

GUARD REQUIREMENTS

Figure 24 requires that openings not allow the passage of a 4" diameter sphere. However, it does not address openings underneath a fixed deck bench used in place of guards. All openings, including those underneath benches used in place of guards, shall not allow the passage of a 4" diameter sphere.

Additionally, if fixed seating is adjacent to guards, the guard height should be measured from the seat rather than the deck surface. This will help minimize exposure

to falls over the top of the guard due to individuals standing on deck seats.

IRC Table R301.5 requires guard in-fill components (all those except the handrail), balusters, and panel fillers to be designed to withstand a horizontally applied normal load of 50 pounds on an area equal to 1 square foot. This load need not be assumed to act concurrently with any other live load requirement. Baluster connection requirements shown in Figure 24 have been designed to resist that load.

GUARD POST ATTACHMENTS

Both the *IRC* and *International Building Code (IBC)* specify that guardrails and handrails be capable of resisting a minimum concentrated live load of 200 lbs applied in any direction. Commonly used residential guardrail post connections were laboratory tested at the required load level for a code-conforming assembly per the *IBC* (Loferski et al., 2006). A commercially available connector, typically used in shear wall construction, was tested in a post-to-deck residential guardrail assembly. The connection passed a load test based on code provisions for a “tested assembly.” Connection details in Figures 25 and 26 reflect these test results.

A minimum requirement of 1,800 lbs for the hold down connector ensures adequate capacity (Loferski et al., 2005) for a 36" maximum rail height. A higher rail height requires design of a higher capacity connector. Manufacturers' tabulated values for hold down connectors typically include a load duration (C_D) increase of 60% since connectors for shear walls are used to resist wind and seismic loads. The 200 lbs concentrated load requirement for guard rails is assumed to be a 10 minute load duration (e.g. it would not see a maximum 200 lbs outward load for more than 10 minutes cumulatively in its lifetime). Therefore, $C_D=1.6$ is used for hold downs in this application.

This section requires deck guard posts to be at least 4x4 nominal with a reference bending design value not less than 1,100 psi to ensure sufficient bending stress in the post. Assuming the lever arm is 39.5" (36" + 1.5" deck board + 2" edge distance), the bending moment is 39.5" x 200 lbs = 7,900 in-lbs. Bending stress, f_b , is calculated as follows:

$$M/S_{(4x4)} = 7,900 \text{ in-lbs} / 7.146 \text{ in}^3 = 1,106 \text{ psi.}$$

No. 2 grades of all Table 2 species meet this requirement with the following assumptions. The adjusted bending design value, F'_b , is based on a wet service factor, $C_M = 0.85$, and incising factor, $C_i = 0.80$ (Douglas fir-larch, hem-fir, spruce-pine-fir). A load duration factor, $C_D = 1.6$, is assumed for consistency with the hold down device used to connect the guard to the joist.

Figures 25 and 26 show minimum and maximum spacing requirements for bolts in deck joists and deck rim boards. The 5" maximum spacing is per footnote 2 of *NDS* Table 11.5.1D. This requirement is based on potential shrinkage of the joist or rim board which could create tension perpendicular to grain stresses if the outer edges of the deck joist or rim are constrained by bolts.

STAIR REQUIREMENTS

Figure 29 shows 5/4 boards spanning 18" or less. As noted under DECKING REQUIREMENTS commentary, specific products classified by size as decking are usually assigned a recommended span of 16" or 24".

Additionally, IRC Table R301.5 footnote (c) requires a 300 lb concentrated load check on stair treads. Analysis revealed that 2x6 No. 2 southern pine works for a 34.5" span (36" – 3/4" bearing at each end) when the 300 lbs is

distributed across 2 inches (e.g. 150 pli). This is based on L/288 deflection criteria (ICC ES Acceptance Criteria 174 requires 1/8" deflection limit: $36"/0.125" = 288$). Other species will not calculate for that span using 2x6.

Solid stringers were analyzed as simple span beams using the horizontal span not the actual stringer length. Cut stringers were analyzed with 5.1" depth which is based on 7.75:10 rise to run ratio. A size factor, C_F , of 1.0 is used since 2x12 is the size basis.

STAIR FOOTING REQUIREMENTS

Stair stringers should be supported by bearing at the end where the stairway meets grade. The detail shown assumes a 40 psf live load and 10 psf dead load over a tributary area of 18" and one-half of the maximum span permitted for solid stringers (16'-6" for southern pine and 13'-3" for other species). This calculates to 625 lbs and 500 lbs, respectively. For southern pine, seven #8 wood screws would be required. Northern species would

require eight #8 wood screws (16d box or common nails would be comparable).

While bolts are sometimes used for this detail, proximity to the end of the stringer could lead to splitting of the stringer – especially cut stringers. The 2x4 bearing block alleviates this situation. However, in addition to the bearing block, bolts would also be required to provide lateral support if a guard post is used.

FRAMING AT CHIMNEY OR BAY WINDOW

IRC R502.10 on framing of openings states: "Openings in floor framing shall be framed with a header and trimmer joists. When the header joist span does not exceed 4', the header joist may be a single member the same size as the floor joist. Single trimmer joists may be used to carry a single header joist that is located within 3' of the trimmer joist bearing. When the header joist span exceeds 4', the trimmer joists and the header joist shall be doubled and of sufficient cross section to support the floor joists framing into the header. Approved hangers shall be used for the header joist to trimmer joist connections when the header joist span exceeds 6'..."

where the header frames into it – designated as dimension "a" – must be limited. The maximum distance was calculated based on joist spans given in Table 2. A maximum distance of $a = 3'$ was chosen to cover common framing conditions. Triple trimmer joists are required on each side of the header if joist spacing is 12" or 16" o.c., or if the trimmer joist span exceeds 8'-6"; otherwise a double trimmer joist is permitted. If "a" is less than that shown in Table C7a, a double trimmer joist is also permitted.

Bending and shear were checked to determine the reduction in a double trimmer joist span when carrying a 6' header. For a simple span beam, with a concentrated load offset from the center, maximum moment is calculated as Pab/L_j and maximum shear is calculated as Pb/L_j , where P is the concentrated load based on the tributary area carried by the header, $b = L_j - a$, and L_j is the trimmer joist span.

Trimmer Joist Size and Span Limited by Concentrated Load from the Header

Where the header frames into the trimmer joist, a concentrated load is created. This condition was evaluated assuming one ply of a double trimmer joist carries the uniform load and one ply carries the point load from a 6' header. The analysis revealed that the distance from the end of the trimmer joist to the point

Moment controlled for this analysis in determining a_{max} . While shear was evaluated, the NDS permits the shear load to be reduced within a distance "d" (equal to the joist depth) from the end of the joist. With that reduction, shear did not control any of the spans evaluated.

Table C7a. Maximum Distance “a” from Trimmer Joist End to a Point where a 6’ Header Frames into a 2-ply Trimmer Joist.

Species Trimmer	Size	a _{max}
Southern Pine	2-2x8	18"
	2-2x10	24"
	2-2x12	29"
Douglas Fir-Larch, Hem-Fir, SPF ¹	2-2x8	14"
	2-2x10	16"
	2-2x12	19"
Redwood, Western Cedars, Ponderosa Pine ² , Red Pine ²	2-2x8	14"
	2-2x10	16"
	2-2x12	18"

1. Incising assumed for refractory species including Douglas fir-larch, hem-fir, and spruce-pine-fir.
2. Design values based on northern species with no incising assumed.

The trimmer hanger capacities listed in Table 7 are based on southern pine joist spans at 12" o.c. or 16" o.c. spacing (whichever controls). The reaction is a combination of the concentrated header load P_b/L_j and the tributary uniform load between the trimmer and the next adjacent joist. Another way of tabulating trimmer hanger capacities is shown in Table C7c based on trimmer spans. Linear interpolation of tabulated values is permitted.

Trimmer Joist Span Limited by Concentrated Load on the Ledger

Bolts or lag screws used to attach the trimmer hanger to the ledger are required to fully extend through the ledger into the band joist or rim board. If a typical face mounted hanger is installed where only nails are used to attach the hanger to the ledger, the ledger would carry a large portion of the load. Since a concentrated load would be created on the ledger, it would be resisted by the bolts at the end of the ledger. As discussed under **LEDGER ATTACHMENT REQUIREMENTS**, the provisions for minimum distance, d_c , between the top of the ledger and the bottom row of fasteners (Figure 19) is based on *NDS* 3.4.3.3(a) for shear design at connections. Based on this analysis, trimmer joist lengths would need to be limited to the maximum trimmer joist spans shown in Table C7b, regardless of the trimmer joist species or number of plies. Since this analysis is based on a simple span trimmer joist, a trimmer joist with an overhang of up to $L_j/4$ would be conservative. The load on the end of the cantilever would reduce the reaction at the ledger.

Table C7b. Maximum Trimmer Joist Span (L_j) Based on Distance “a” from the Trimmer Joist End to the Point where the Header Frames into the Trimmer.^{1,4}

Ledger Species	Size	a = 1'	a = 2'	a = 3'
Southern Pine	2x8	5' - 9"	7' - 5"	8' - 11"
	2x10	9' - 2"	10' - 11"	12' - 7"
	2x12	9' - 5"	11' - 2"	12' - 10"
Douglas Fir-Larch, Hem-Fir, Spruce-Pine-Fir ²	2x8	4' - 6"	6' - 0"	7' - 6"
	2x10	6' - 10"	8' - 6"	10' - 1"
	2x12	7' - 0"	8' - 9"	10' - 4"
Ponderosa Pine ³ , Red Pine ³ , Redwood, Western Cedar	2x8	4' - 3"	5' - 9"	7' - 3"
	2x10	6' - 5"	8' - 1"	9' - 8"
	2x12	6' - 7"	8' - 3"	9' - 10"

1. Assumes 6' header span. See Figure 35 for header, trimmer, and ledger framing details.
2. Incising assumed for refractory species including Douglas fir-larch, hem-fir, and spruce-pine-fir.
3. Design values based on northern species with no incising assumed.
4. Shading indicates where triple trimmers are required. See text for alternate 2-ply trimmer conditions.

Table C7c. Trimmer Joist Hanger Download Capacity Based on Trimmer Span.

Trimmer Span	Minimum Capacity, lbs
8'	660
10'	860
12'	1060
14'	1260
16'	1460
18'	1500

Examples

1) Assume a 2x10 redwood joist spanning 12'-0" at 16" o.c. (per Table 2) framing around a 5' wide by 2.5' deep chimney. Set a 6' header 3' from the end of the trimmer joist. A triple trimmer joist is required since the span exceeds 8'-6". If the trimmer hanger does not attach through the ledger to the rim board or band joist, the trimmer joist span is limited to 9'-8" per Table C7b.

Several solutions exist:

- Reduce all joist spans to 9'-8".
- $L_j/4 = 2'-5"$ so $L_j + L_j/4 = 12'-1"$ total joist length, which would provide the same square footage.
- Place a post under the center of the header to reduce the header span.

2) Assume a 2x8 western cedar joist spanning 8'-0" at 24" o.c. (per Table 2) framing around a 5' wide by 1.5' deep bay window. Set a 6' header 2' from the end of the trimmer joist. A double trimmer joist is permitted since the spacing is 24" o.c. If the trimmer hanger does not attach through the ledger to the rim board or band joist, the trimmer joist span is limited to 5'-9" per Table C7b. Several solutions exist:

- Reduce all joist spans to 5'-9".
- Place a post under the center of the header to reduce the header span.
- Increase joist size to 2x10 which will span 8'-1" per Table C7b.

3) Assume a 2x12 southern pine joist spanning 18'-0" at 16" o.c. (per Table 2) framing around a 5' wide by 1.5' deep bay window. Set a 6' header 2' from the end of the trimmer joist. A double trimmer joist is permitted since $a = 24"$ which is less than $a_{max} = 29"$ in Table C7a.

However, if the trimmer hanger does not attach through the ledger to the rim board or band joist, the trimmer joist span is limited to 11'-2" per Table C7b. Several solutions exist:

- Reduce all joist spans to 11'-2".
- Place a post under the center of the header to reduce the header span.

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ASTM. *ASTM D2555 - 06 Standard Practice for Establishing Clear Wood Strength Values*. West Conshohocken, PA. 2006.

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Loferski, Joseph R., Dustin Albright, and Frank E. Woeste. "Tested Guardrail Post Connections for Residential Decks." *Wood Design Focus*. Vol. 16, No. 2. Forest Products Society. Madison, WI. Summer 2006.

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APPENDIX

SAFETY GLAZING REQUIREMENTS: IRC

R308.4 states that safety glazing in window glass is required when the existing house wall acts as a barrier to adjacent stairs, landings, and areas at the top and bottom of stairs. If a window or portion thereof falls within the area shown in Figure A1, glass panes within that area should be safety glazed. Safety glazing should reduce injury due to accidental impact when ascending or descending stairs. Application of safety glazing film to glass that was not originally treated is acceptable to meet this requirement.

Exceptions to this requirement include:

- When a protective bar is installed on the accessible side(s) of the glazing 36" \pm 2" above the deck surface. The bar shall be capable of withstanding a horizontal load of 50 plf without contacting the glass and be a minimum of 1- $\frac{1}{2}$ " in height.
- The side of a stairway, landing, or ramp has a guardrail or handrail, including balusters or in-fill panels, complying with the provisions of Sections R311.7.6 and R312 and the plane of the glass is more than 18" from the railing.
- When a solid wall or panel extends from the plane of the adjacent walking surface to 34" - 36" above the floor and the construction at the top of that wall or panel is capable of withstanding the same horizontal load as the protective bar.

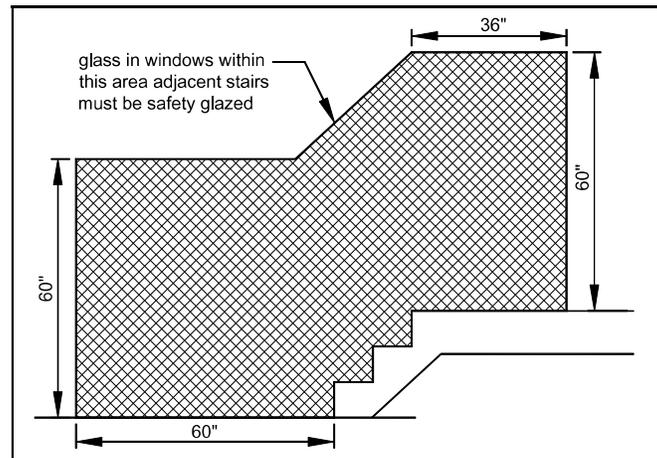
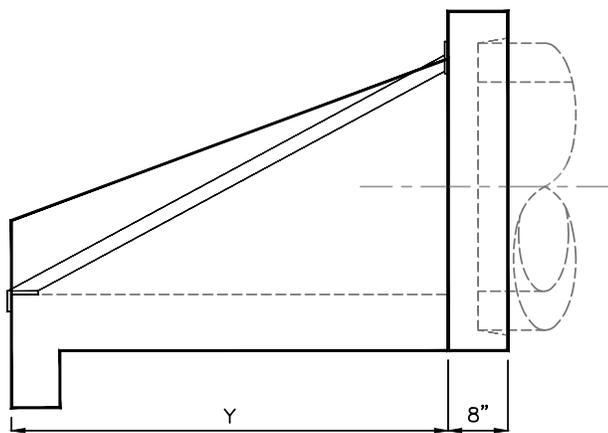


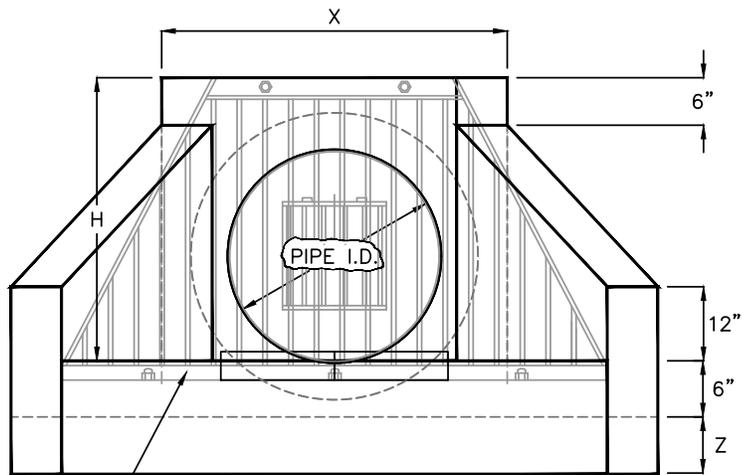
Figure A1. Safety glazing requirements.

Appendix B: Drainage Exit Structure Headwall

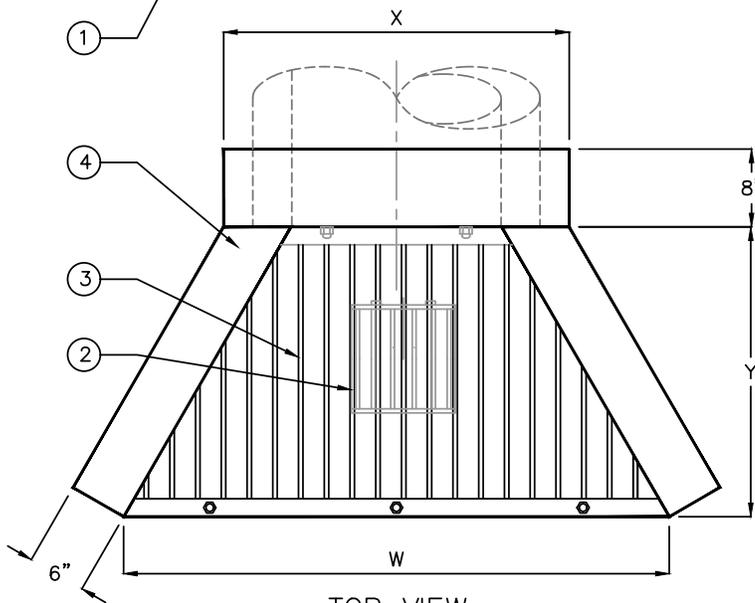
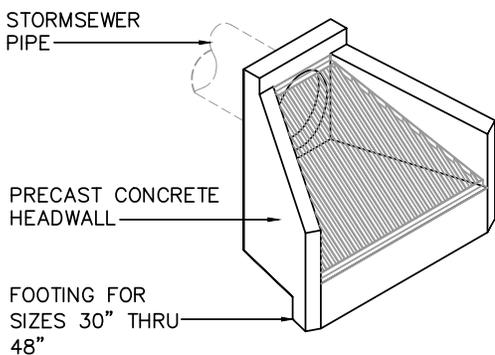
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SIDE VIEW



FRONT VIEW



TOP VIEW

MODEL	PIPE DIA	DIMENSIONS					WEIGHT (LBS)
		H	W	X	Y	Z	
DSA-12	12"	2'-6"	4'-3"	3'-0"	2'-0"	-	2,700
DSA-15	15"	2'-6"	4'-3"	3'-0"	2'-0"	-	2,700
DSA-18	18"	2'-6"	4'-3"	3'-0"	2'-0"	-	2,600
DSA-21	21"	3'-0"	5'-10"	3'-2"	3'-0"	-	4,300
DSA-24	24"	3'-0"	5'-10"	3'-2"	3'-0"	-	4,200
DSA-30	30"	3'-6"	7'-6"	4'-1"	4'-0"	9"	6,200
DSA-36	36"	4'-1"	9'-3"	4'-8"	5'-0"	9"	8,100
DSA-42	42"	4'-11"	12'-6"	5'-10"	6'-0"	12"	11,000
DSA-48	48"	4'-11"	12'-6"	5'-10"	6'-0"	12"	11,000

KEYED NOTES		
MARK	QTY	DESCRIPTION
1	1	1-1/2" X 1/4" GALVANIZED ANGLE BOLTED TO CONCRETE WITH 1/2" ANCHOR BOLTS
2	1	12"x12" HINGED CLEAN OUT GRATE
3	1	GALVANIZED STEEL DEBRIS GRATE, 1-1/2" X 3/16" BARS @ 2" O.C. 1" CLEAR OPENING
4	1	DRAINAGE EXIT STRUCTURE MFG: PARK USA 888-611-PARK WWW.PARKUSA.COM MODEL: DSA-1 DATE MANUFACTURED:



SPECIFICATIONS

CONCRETE : Class I/II concrete with of design strength of 4500 PSI at 28 days. Unit is of monolithic construction including walls and floor.

REINFORCEMENT: Grade 60 reinforced. No. 4 steel rebar to conform to ASTM A615 on required centers or equal. Bar bending and placement shall with the latest ACI standards.

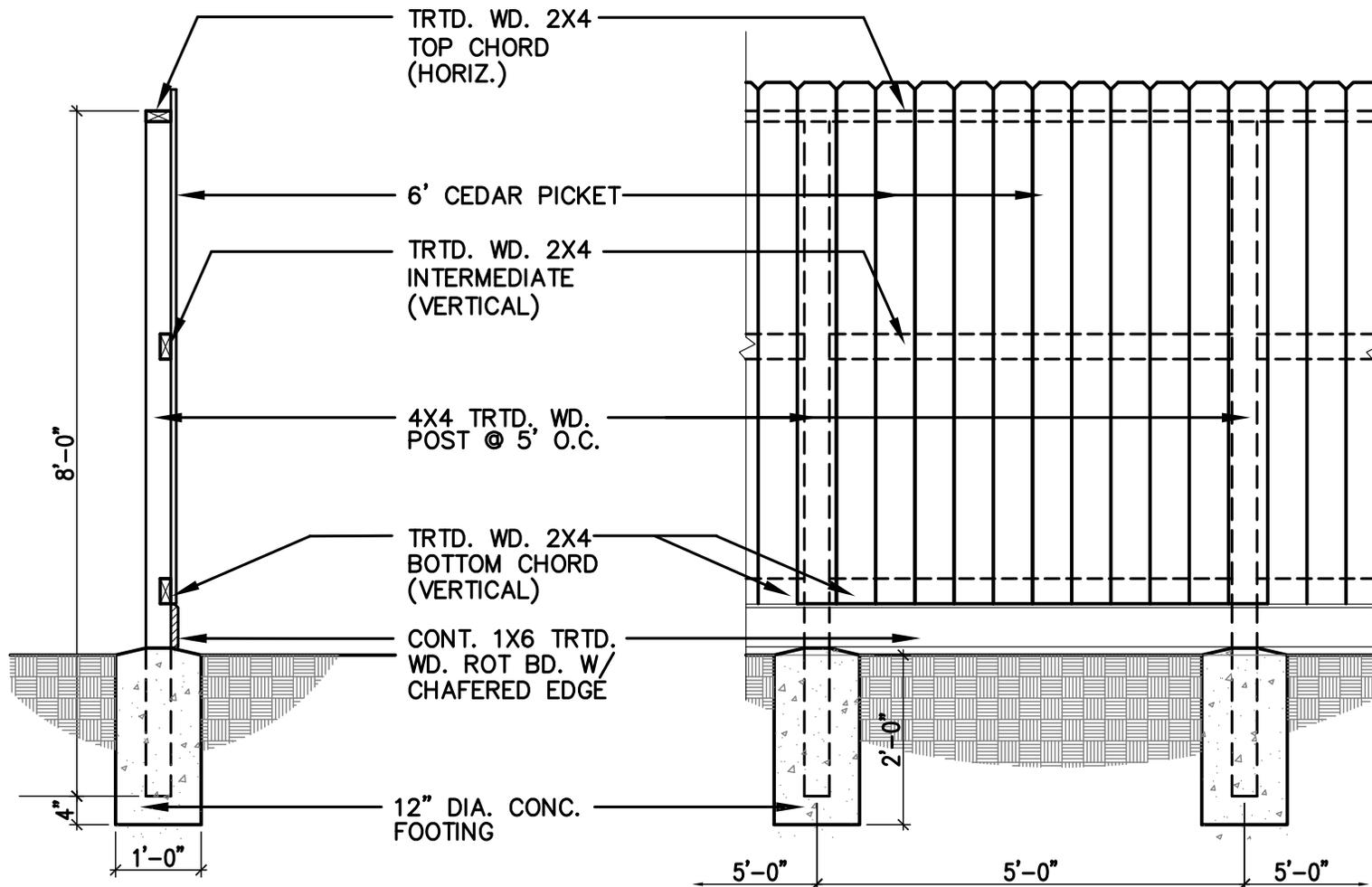
GRATING: All steel fabrication shall be in accordance to AWA D1.1. Steel shall be ASTM A36 carbon steel, and hot-dipped galvanized after fabrication in accordance to ASTM A123

PROJECT: .	
CUSTOMER: .	
ENGINEER: .	
ORDER #: .	PROJ #: .
DATE: .	LOCATION: .
www.parkusa.com 888-611-PARK	
DRAINAGE EXIT STRUCTURE MODEL DSA 12" THRU 48"	
PM .	PC .
DRN .	ENG .
DWG. NO. .	
DATE 01/2019	DSA-1
REV. .	

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Appendix C: Wood Fence Detail

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SECTION

ELEVATION



TYPICAL FENCE CONSTRUCTION DETAILS

HCDD MINIMUM CONSTRUCTION STANDARDS

DIAGRAM 2023-01A

HOUSING AND COMMUNITY DEV.

