

Checklist for Design Engineers and Architects – Residential Construction

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Considering using items on this checklist to prevent-through-design many common safety and health hazards during the construction and maintenance of residential buildings. *Prevention through Design (PtD) recognizes that design engineers and architects have the ability to proactively “design out” potential hazards to eliminate or minimize the risk and improve worker safety and health. Hence, this checklist, used during the planning and design phase and beyond, may assist design engineers and architects working closely with construction teams to identify and eliminate some of the potential hazards commonly present during residential construction and maintenance. To increase PtD application and decrease uncertainty in the scope of work, any PtD controls should be included up front in bids and contracts associated with the construction and maintenance, and clearly called out in plans and drawings.*

Design Engineer Codes: CE = Civil, EE = Electrical, ME = Mechanical, SE = Structural, PE = Project

| Component | Design Risk | PtD Controls | Architect | Engineer |
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| Framing, Painting, and Trim | Working from ladders presents a risk of injury from falls. By minimizing ladder use, fall risks can be decreased. | • Design interiors that minimize ladder use for finish work such as lower ceilings or eliminating trim around high windows | ✓ | SE |
| | | • Design roofs with easy access or access from upper interior levels (no ladder required) | ✓ | SE |
| | | • Locate exterior flatwork adjacent areas that may require work at height to provide stable surfaces | ✓ | SE |
| | | • Design interior and exterior spaces to accommodate the use of manlifts instead of ladders | ✓ | SE |
| | | • Schedule exterior flatwork to be completed early to provide stable surfaces for ladder placement | - | PE, SE |
| Roofing | Working on roofs presents a fall risk, often from a substantial height. Sloped roofs also present a risk of struck-by incidents when tools and materials fall onto workers below. | • Specify locations and types of guardrail systems on plans | ✓ | PE |
| | | • Design anchors (temporary or permanent) for attachment of fall restraint systems | ✓ | SE |
| | | • Add parapets to roof design to provide passive fall protection for workers on the roof | ✓ | PE, SE |
| | | • Design roof pitches to have lower slopes that improve traction and stability of workers | ✓ | SE |
| | | • Specify roofing materials with increased traction to avoid slips on the roof (asphalt shingles as opposed to metal or tile roofs) | ✓ | PE |
| | | • Locate rooftop features (e.g., vents, skylights, drains) to minimize tripping hazards and allow for safe and easy movement while on the roof | ✓ | SE |
| | | • Design a flat area on the roof for safely loading roofing and solar components during installation and future roof maintenance | ✓ | SE |
| | | • Plan for roof work during dry seasons | - | PE |

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| | | <ul style="list-style-type: none"> Perform roof inspections with a drone or other remote visualization device to eliminate the need for a person on the roof | - | ME, SE |
| Electrical | Working with electrical wiring and equipment can present a risk of electrocution. | <ul style="list-style-type: none"> Design centrally-accessible temporary power during construction that is grounded and GFCI protected | ✓ | PE |
| | | <ul style="list-style-type: none"> Specify underground service lines as opposed to overhead wiring to prevent accidental contact and electrocution | ✓ | CE, PE |
| | | <ul style="list-style-type: none"> Design electrical equipment and wiring in lower level, easily accessible locations to reduce fall risks | ✓ | EE, ME |
| Solar | Installing and maintaining solar systems can present a risk of electrical hazards and falls from roofs. | <ul style="list-style-type: none"> Minimize roof penetrations that cause tripping hazards and add complications to array installations | ✓ | ME, SE |
| | | <ul style="list-style-type: none"> Specify pre-wiring for solar and installation of conduit and raceways during initial construction to decrease additional work on the roof after building construction is complete | ✓ | ME, EE |
| | | <ul style="list-style-type: none"> Specify anchor points (temporary or permanent) for attachment of fall restraint systems | ✓ | SE |
| | | <ul style="list-style-type: none"> Design a simple roof shape for simpler installation | ✓ | SE |
| | | <ul style="list-style-type: none"> Avoid placing overhead electrical service lines over solar zones | ✓ | ME, PE |
| | | <ul style="list-style-type: none"> Ensure there is room for access pathways for roof maintenance and emergency operations on the roof | ✓ | ME, PE, SE |
| | | <ul style="list-style-type: none"> Specify modular solar systems that can be built on the ground and lifted to the roof in one piece | - | ME |
| Floor and Roof Openings, Windows, Leading Edges, Stairs, and Skylights | Unprotected openings, leading edges, stairs, windows and skylights can lead to a risk of falls from heights. | <ul style="list-style-type: none"> Specify locations of guardrail systems (temporary or permanent) on plans | ✓ | PE |
| | | <ul style="list-style-type: none"> Design stairwell openings in areas that allow easy guardrail installation | ✓ | SE |
| | | <ul style="list-style-type: none"> Specify reinforced/shatterproof skylights or design skylight guardrails into the plans to prevent workers on the roof from falling through skylight openings | ✓ | PE |
| | | <ul style="list-style-type: none"> Specify modularization or pre-fabrication of components on the ground and lifting into place, including roof sections, roof trusses, floor framing, upper-level walls, and modular rooms | ✓ | ME, PE, SE |
| | | <ul style="list-style-type: none"> Place stairwell openings in areas with less foot traffic to decrease the risk of falling through stairwell openings | ✓ | SE |
| | | <ul style="list-style-type: none"> Eliminate tripping hazards (e.g., changes in elevation, curbs, etc.) around floor openings | ✓ | ME, SE |
| | | <ul style="list-style-type: none"> Specify gutters, soffit, and trim materials that do not require painting to decrease ladder use | ✓ | PE |
| | | <ul style="list-style-type: none"> Design upper story window sill heights such that they act as guardrails for fall protection | ✓ | PE |
| | | <ul style="list-style-type: none"> Perform upper-level inspections with a drone or other remote visualization device to eliminate the need for a person on elevated surfaces | - | PE, SE |
| Trenching and Excavation | Unsupported trenches and excavations can | <ul style="list-style-type: none"> Design engineered shoring systems (e.g., sheet piling and soldier piles) to protect foundation excavations and prevent cave-ins | ✓ | CE |

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| | lead to a risk of injury or death from cave-ins. | <ul style="list-style-type: none"> Specify sloped or benched excavation to minimize cave-ins and reduce the need for shoring | - | CE |
| Concrete and Masonry | Flatwork set-up and finishes can lead to unsafe walking surfaces. Masonry and complex concrete walls can increase fall and struck-by hazards. | <ul style="list-style-type: none"> Specify 4" x 4" mat mesh or welded wire fabric (WWF) on top of more widely spaced rebar to provide a safer walking surface during concrete pours | ✓ | CE, SE |
| | | <ul style="list-style-type: none"> Eliminate offsets and other complicated shapes which increase cave-in hazards | ✓ | - |
| | | <ul style="list-style-type: none"> Design the covers over sumps, outlet boxes, drains, etc., to be flush with the finished floor | ✓ | ME, SE |
| | | <ul style="list-style-type: none"> Keep steps, curbs, slab depressions, and other similar floor features away from window openings, exterior edges, and floor openings | ✓ | ME, PE, SE |
| | | <ul style="list-style-type: none"> Specify a non-slip walking surface on walkways and platforms that are adjacent to open water or are exposed to the weather | ✓ | - |
| | | <ul style="list-style-type: none"> Restrict masonry finishes only to ground-level areas to decrease the need for masonry work on scaffolding which can lead to falls and struck-by hazards | ✓ | PE |
| Mechanical | Improper mechanical room design can make access challenging and lead to struck-by hazards. | <ul style="list-style-type: none"> Provide adequate headroom for access to equipment, control panels, and storage areas | ✓ | ME, PE |
| | | <ul style="list-style-type: none"> Locate mechanical equipment on the ground rather than on the roof or within an attic space | ✓ | ME, PE |
| | | <ul style="list-style-type: none"> Design utility lines with exterior color codes or markings to allow for easy identification of the contents | ✓ | ME, PE |
| Miscellaneous | Additional unclassified hazards can cause injury from struck-by incidents, traumatic injuries and noise. | <ul style="list-style-type: none"> Design overhangs (e.g., porches or balconies) that don't need temporary support during construction to prevent unstable or temporarily-supported structures that can collapse and strike a worker | ✓ | SE |
| | | <ul style="list-style-type: none"> Specify standard sizes or pre-cut materials that will eliminate the need for cutting or shaping in the field and decrease cuts, lacerations and noise exposures | ✓ | ME, PE, SE |

Sources:

<https://www.cdc.gov/niosh/docs/2014-108/pdfs/2014-108.pdf> NIOSH doc Preventing Falls through the Design of Roof Parapets

NAHB Video Toolbox Talks: <https://www.nahb.org/advocacy/industry-issues/safety-and-health/safety-365/video-toolbox-talks#sort=@created> descending

CPWR Applying Prevention through Design (PtD) to Solar Systems in Small Buildings
<https://www.cpwr.com/wp-content/uploads/publications/PtD-Solar-Solar-Systems-in-Small-Buildings.pdf>

Choi, S. D., & Carlson, K. (2014). Occupational safety issues in residential construction surveyed in Wisconsin, United States. *Industrial health*, 52(6), 541-547.

Gambatese, J. & Lujan, R. PtD Reinforced Concrete Design Education Module. Oregon State University.