Notice

Any opinions, findings, conclusions, or recommendations expressed in this publication do not necessarily reflect the views of the Applied Technology Council (ATC), the Department of Homeland Security (DHS), or the Federal Emergency Management Agency (FEMA). Additionally, neither ATC, DHS, FEMA, nor any of their employees, makes any warranty, expressed or implied, nor assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, product, or process included in this publication. Users of information from this publication assume all liability arising from such use.

Cover photograph – Photograph showing masonry chimney.


Overview

Purpose and Scope

This Plan Set is for retrofit of masonry chimneys and is provided as a supplement to FEMA P-1100, *Vulnerability-Based Seismic Assessment and Retrofit of One-and Two-Family Dwellings, Volume 1 – Prestandard*. The Plan Set presents prescriptive, pre-engineered plans for a suggested minimum level of retrofit design for use by a general contractor or homeowner without necessarily having to involve a registered design professional. Use of this Plan Set is limited to dwellings that are compliant with eligibility statements presented in Table 1 on Sheet S0. The extent of the scope of this Plan Set is described on Sheet S0.

The Plan Set is intended to contain all of the necessary supplemental technical information and guidance for preparation of a complete set of plans for submittal to the local building department and for use during construction; however, supplemental information may be required by some building departments. Note that building permits are always required when performing the work described in this Plan Set.

The Plan Set does not attempt to address all potential deficiencies in a home and does not eliminate the risk of potential damage in future earthquakes.

Instructions for use are provided on Sheet S0.

Limitation of Liability

Earthquake strengthening constructed in accordance with this Plan Set is intended to reduce the risk of earthquake-related damage to existing residential wood-frame dwellings with masonry chimneys. The content of this Plan Set is based on the experience and judgment of practicing engineers and limited research. All circumstances, forms, or types of construction have not necessarily been contemplated in the preparation of this Plan Set, and it is not possible to control the quality of construction or predict or test all conditions that may occur during an earthquake. No party associated with the preparation of this Plan Set makes any representation, warranty, or covenant, expressed or implied, with respect to the design, condition, quality, durability, operation, fitness for use, or suitability of earthquake strengthening based on this Plan Set.
INSTRUCTIONS FOR USE

A. Before you begin:

1. This plan set is intended for use by a general contractor or homeowner without necessarily having to involve a registered design professional.
2. Contact your local building department to understand the building permit application process. Ask about:
   a. Fees.
   b. How many copies of the plan must be submitted, and
   c. Which city inspections are required.
3. The building official may also be able to assist with assessing the applicability of this plan set to a home. See Eligibility For Use, Sheet S0, Table 1.
4. Complete the Eligibility For Use questionnaire on Sheet S0 to determine if this plan set is applicable. A "non-compliant" answer to any question disqualifies the home from using this plan set.

B. Prepare your plan set:

1. Draw a scaled plan of the home in the space provided on Sheet S0, Detail 1. Your plan should include the following:
   a. The general outline of the home. It is helpful to draw roof ridge, hips, and valleys.
   b. The front (street) side of the home and the back side of the home.
   c. A north arrow.
   d. The location of the chimney to be retrofitted.
   e. Chimney dimensions "A," "B," and "H" as shown in Detail 3 on Sheet S2.
   f. See Sheet X1 for an example plan.

C. Gather information to complete the plan set:

1. Review general notes on Sheet S1 for guidance on materials and installation for the required work.
2. Use Table 2 on Sheet S0 to determine which retrofit methods are applicable to your home and chimney.
3. If several retrofit methods are applicable, choose the preferred method, and identify the sheet that gives applicable details (choose one of Sheets S3 through S6).
4. Determine whether Details 1 and 2 on Sheet S2 are required based on Note 4 on Sheet S4 or S5, or Note 3 on Sheet S6.

D. Complete your plans:

1. In the space provided in Detail 1, Sheet S0, draw a plan of the dwelling with the chimney location shown. Note on the dwelling plan the chimney to be retrofitted.
2. If braces per Details 1 and 2 on Sheet S2 required, note on the Sheet S0 plan the approximate location and provide a reference to the details.
3. Complete the Eligibility For Use questionnaire on Sheet S0 to determine if this plan set is applicable. A "non-compliant" answer to any question disqualifies the home from using this plan set.

E. Submit your plans to the building department:

1. In the space provided in Detail 4, Sheet S0, submit a permit application and the required number of complete plan sets to the building department for review.
2. If several retrofit methods are applicable, choose the preferred method, and identify the sheet that gives applicable details (choose one of Sheets S3 through S6).

F. Submit your plans to the building department:

1. The submitted plan set should always include Sheets S0 and S1. If Details 1 and 2 on Sheet S2 are to be used, the submitted plan set should also include Sheet S2. Finally, also include the one sheet that is to be used for the chimney retrofit (include one only of Sheets S3 through S6, do not submit sheets that are not being used).
2. Submit a permit application and the required number of complete plan sets to the building department for review. Photographs of the chimney to be retrofitted may assist the review process.
3. Before beginning work, the permit holder may be required to schedule an inspection with the building department to verify that field conditions are consistent with the information provided on the approved plans.
4. Inspections by the building department during the retrofit work may be required for:
   a. Foundation and rebar prior to placing concrete
   b. Foundation anchor bolts
   c. Anchorage to existing masonry and adaptor core installation
   d. Framing
   e. Fire blocking
   f. Flue and flue cap installation

Abbreviations:

(NTS) Not To Scale
 typ. Typical
(E) Existing
(N) New
max. Maximum
min. Minimum

Table 1: ELIGIBILITY FOR USE

<table>
<thead>
<tr>
<th>Chimney Location</th>
<th>Chimney Height</th>
<th>Unbraced Portion Minimum Requirements for Compliance</th>
<th>Sheet</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exterior</td>
<td>Any</td>
<td>Demolish down to base (shoulder) of the chimney at the lowest floor box.</td>
<td>S4, S5, or S6</td>
</tr>
<tr>
<td></td>
<td>Two or Three Stories</td>
<td>Demolish to or calling directly below unbraced portion.</td>
<td>S3, S4, or S5</td>
</tr>
<tr>
<td>Interior</td>
<td>One Story</td>
<td>No portion of the chimney is free-standing (not in contact with a wall on any of the four sides) for a height of more than six feet.</td>
<td>S4, S5, or S6</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Demolish to roof.</td>
<td>S3, S4, or S5</td>
</tr>
</tbody>
</table>

Table 2: DETERMINATION OF RETROFIT SCOPE

Use this table to determine which retrofit in Sheets S3 to S6 is permitted for the home. See Detail 3 on Sheet S2 for definitions of dimensions B and H.

<table>
<thead>
<tr>
<th>Chimney Location</th>
<th>Chimney Height</th>
<th>Unbraced Portion Minimum Requirements for Compliance</th>
<th>Sheet</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exterior</td>
<td>Any</td>
<td>Demolish down to base (shoulder) of the chimney at the lowest floor box.</td>
<td>S4, S5, or S6</td>
</tr>
<tr>
<td></td>
<td>Two or Three Stories</td>
<td>Demolish to or calling directly below unbraced portion.</td>
<td>S3, S4, or S5</td>
</tr>
<tr>
<td>Interior</td>
<td>One Story</td>
<td>No portion of the chimney is free-standing (not enclosed by full-height, finished walls on at least three sides) for a height of more than six feet, and the chimney extends a height (dimension H) more than two times dimension B (2xB) above the roof.</td>
<td>S4, S5, or S6</td>
</tr>
</tbody>
</table>
D. NOTCHING, BORING, AND CUTTING

1. Do not cut bores, or notch structural members except as shown in these drawings or as specifically permitted by the building inspector.

Exception: Notching and boring of framing shall be permitted as per Chapter 6 of the International Residential Code (IRC).

2. When drilling in masonry, do not drill through existing reinforcing steel. If reinforcing steel is hit during drilling, move a minimum of one inch and drill relocated hole. Fill original hole with non-shrink grout.

E. CONCRETE

1. Concrete shall have a strength of not less than 3000 psi at 28 days (design based upon 2500 psi). Concrete mixed on site shall be mixed and placed in accordance with the manufacturer’s instructions using potable water.

F. REINFORCING STEEL (REBAR)

1. Reinforcing steel shall conform to ASTM A615 Grade 40 or 60, ASTM A706, or ASTM A996 Type H.

2. Reinforcing steel bend radii and other rebar detailing shall be in accordance with Concrete Reinforcing Steel Institute.

3. Minimum concrete cover over reinforcing steel:

   a. Concrete cast against and permanently exposed to soil: 3 inches
   b. Concrete not exposed to weather or in contact with soil: 1-1/2 inch
   c. Reinforcing steel lap splice lengths: No. 4 No. 5

   • Horizontal bars with more than 12 inches concrete below: 32 inches 42 inches
   • Other bars: 24 inches 32 inches

G. STRUCTURAL STEEL

1. Structural steel mullion-like steel shall be ASTM A36, A992 or ASTM A572. Welding shall comply with AWS D1.1 requirements using prequalified welding procedures. All welding shall be conducted by welders certified for the materials and welding procedures used.


3. Steel sheet for brick chimney adapter cones shall conform to ASTM A603, Structural Steel Grade 33 Type H or Grade 50, Type H. Welding shall conform to AWS D1.3.

H. FASTENERS

1. All bolts, nails, and other fasteners in contact with preservative-treated wood or exposed to weather shall be hot-dip galvanized or stainless steel.

2. Nails:

   a. Unless otherwise noted, all nails specified are to be common nails.
   b. Special care is required when installing nails in existing framing. Where required to avoid splitting of framing, predrill to 75% of nail shank diameter.
   c. Fasteners for wood structural panel sheathing shall be full length 8d common nails (0.131” x 2-1/2”). Drive sheathing nail head flush with face of sheathing. Do not overtighten, overdrive, or otherwise damage the overlaminate ply when installing nails. A nail is over-driven when it breaks the surface ply. Where nails are overdriven to the point that the plywood face is fractured, add one new nail for every 2 overdriven nails. Space new nails between existing.

3. Anchors:

   a. Predrill bolt holes to not more than 1/16th inch larger than bolt or anchor bolt to be placed.
   b. Provide cut washer between bolt head or nut and wood member where bolt or nut bears on wood.

4. Anchor Bolts:

   a. Predrill bolt holes to not more than 1/16th inch larger than bolt or anchor bolt to be placed.
   b. Provide cut washer between bolt head or nut and wood member where bolt or nut bears on wood.

5. Screws:

   a. Screws for cold-formed steel-to-steel connections shall be No 6 self-drilling tapping screws conforming to ASTM C1514.
   b. Screws for attaching structural reinforcement to cold-formed steel wall framing shall have a minimum head diameter of 0.292 inch with countersunk heads and shall be installed with a minimum edge distance of 3/8 inch.
BRACE FOR NEW CHASE

1. Dimensions A, B, and H for use in Tables 1 and 2 on Sheet S0.
2. The dimension B is the small horizontal dimension of the chimney as measured above the roof. The dimension H is the height of chimney that extends vertically above the highest point of the adjacent roof. This figure shows how those measurements are defined for various chimney configurations.

Notes:

Chimneys located at exterior corners not eligible to use this plan set. (See Table 1 on Sheet S0)
SCOPE FOR CAP AT ROOF OPTION

1. Remove masonry above top of the course just above the highest existing roof flashing, but not less than seven inches above roof surface, leaving the upper course undisturbed. A sheet metal cap of galvanized steel or stainless steel shall be provided for weather protection. The cap shall extend not less than three inches down each side of the chimney, overlapping the existing flashing by minimum two inches where it occurs. The cap shall be secured to the chimney with corrosion-resistant fasteners. Deteriorated mortar on masonry below the level of the cap shall be repaired or replaced.

2. Completely and permanently close off the interior of the firebox from the dwelling interior with an infill of gypsum wallboard, wood structural panel sheathing, masonry, or other material, permanently affixed and installed in conformance with provisions of the locally adopted building or residential code.

3. The capped chimney shall not be used to convey products of combustion. Any flues previously discharging products of combustion through the chimney shall be re-routed in accordance with all applicable building or residential code provisions.

SCOPE FOR CAP AT FLOOR OR CEILING OPTION

1. Remove masonry to a distance of not more than eight inches above the top of ceiling or attic floor framing. Cap the chimney with sheet metal. Close the roof opening and weatherproof using framing and roofing materials to match the existing construction. Deteriorated mortar on masonry below the level of the cap shall be repaired or replaced.

2. Completely and permanently close off the interior of the firebox from the dwelling interior with an infill of gypsum wallboard, wood structural panel sheathing, masonry, or other material, permanently affixed and installed in conformance with provisions of the locally adopted building or residential code.

3. The capped chimney shall not be used to convey products of combustion. Any flues previously discharging products of combustion through the chimney shall be re-routed in accordance with all applicable building or residential code provisions.
All construction shall be in accordance with the factory-built chimney manufacturer’s installation instructions and the following requirements. All clearances required by the manufacturer and listing shall be maintained. The reconstruction shall incorporate a UL 153 listed, factory-built chimney with a masonry fireplace adapter tested per UL 103A and listed for use with the specific factory-built chimney.

1. Masonry Firebox. The existing masonry firebox shall remain up to the base of the flue as shown in Detail 2 on Sheet S4.

2. Track or sill plate. Cold-formed steel track sections matching the thickness of the studs shall be provided at the bottom of cold-formed chimney chase walls. Wood sill or sole plates having a width not less than the supported studs shall be provided at the bottom of wood chimney chase walls. Wood sill or sole plates shall be protected against decay by the use of naturally durable wood or wood that is preservative-treated. Fasteners in contact with wood sill or sole plates shall be of hot-dipped, zinc-coated galvanized steel or of stainless steel. Tracks and sill or sole plates shall be anchored to the concrete beam per Detail 1 on Sheet S4.

3. Chimney chase stud walls. Chimney chases shall be constructed of full height stud walls spaced at no more than 12 inches on center. Stud sizes shall be selected based on story clearances. Wood studs shall not be less than nominal two-inch by three-inch. Cold-formed steel studs shall be not less than 43 x 8 inches thick. The top of the chimney chase shall extend not less than 2 feet above the edge of the roof and not less than 2 feet above the maximum roof elevation, or maximum elevation of other construction located within a 10-foot horizontal dimension in any direction from the chimney (Detail 1 on Sheet S2). Where the exterior walls adjacent to the chase are less than 5 feet from the lot line, they shall be constructed with full 2x4 wood or 54 mil (16 gage) 3 ⅝-inch steel studs with exterior sheathing that includes 7/8-inch thick conventional stucco or minimum 1/2 inch thick Type X gypsum sheathing. Check with building department for any additional fire protection requirements in the currently adopted building or residential code. The chimney chase shall be capped, with roofing and flashing to be weatherproof and to match existing construction.

4. Chimney chase connection to dwelling. The chimney chase shall be fastened to the existing residence exterior wall with minimum No. 8 wood screws at 12 inches on center. The chimney chase framing shall be stripped to the existing floor, ceiling and roof framing with not less than two steel straps 1-1/4 inches in thickness in width and 33 mil (20 gage) minimum in thickness, with each strap located on an opposing face of the chase. Each strap shall be fastened to steel blocking between steel studs of the chimney chase with minimum four No. 8 shear metal screws, or to wood blocking between wood studs of the chimney chase with not less than four 8d nails. Each strap shall be fastened to existing floor, roof or ceiling framing with minimum four No. 8 sheet steel screws, or to existing wood floor, roof or ceiling framing with minimum four 8d nails. Where chimney chase walls exceed more than four feet above the highest roof elevation immediately adjacent to the chimney, bracing shall be provided in accordance with this section or in a manner acceptable to the building department. The bracing shall be connected to the chimney chase in the upper third of the chase clear height above the roof (H/3 as shown in Detail 1 on Sheet S2). Bracing angles shall be galvanized or otherwise corrosion resistant and not less than 2 1/2x2-1/2x1/4-inch steel plates spaced at no more than 12 inches on center. Stud sizes shall be selected based on story clearances. The bracing shall not be less than 30 degrees and not more than 60 degrees from vertical.

5. Factory-built chimney. Factory-built chimneys shall be sized such that sound chimney flues shall have a minimum net cross-sectional area of not less than 1/12 of the fireplace opening. Square chimney flues shall have a minimum net cross-sectional area of 1/10 of the fireplace opening. Rectangular chimney flues with an aspect ratio less than 2 to 1 shall have a minimum net cross-sectional area of 1/10 of the fireplace opening. Rectangular chimney flues with an aspect ratio of 2 to 1 or more shall have a minimum net cross-sectional area of 1/8 of the fireplace opening. Factory-built chimneys shall be listed and labeled and shall be installed and tested in accordance with the manufacturer’s instructions. Decorative shrouds shall not be installed at the termination of factory-built chimneys except where the shrouds are listed and labeled for use with the specific factory-built chimney system and installed in accordance with the manufacturer’s instructions. No part of the chimney shall be at an angle of more than 30 degrees (0.52 rad) from vertical at any point in the assembly and the chimney assembly shall not include more than four elbows.

6. Flue cap. Factory-built cap installed in accordance with manufacturer’s instructions and complying with the metal chimney UL listing.

7. Fireblocking. Spaces between chimneys and floors and ceilings through which chimneys pass shall be fireblocked with noncombustible material securely fastened in place. The fireblocking of spaces between chimneys and wood joists, beams or headers shall be self-supporting or be placed on batts of metal or masonry laid across the spaces between combustible material and the chimney. Draft stops consisting of drywall, plywood or OSB shall be provided to separate the chase from wood framing of the dwelling.

8. Chimney cap. A framed chimney cap shall be constructed at the top of the chimney chase.

9. Adapter cone. A 12 gauge (97 mil) minimum thickness galvanized steel sheet adapter cone shall be provided. The cone shall have minimum 12-gauge (97 mil) thickness sheet steel top and bottom plates, and shall provide a smooth-surfaced transition between the flue opening at the top of the firebox and the flue. The bottom plate geometry shall match the opening geometry at the top of the smoke chamber, and the adapter geometry shall be coordinated with the flue. The adapter cone shall be set in cementitious grout, and all cone seams shall be continuously welded.

10. Cone bottom plate. The adapter cone bottom plate shall be anchored to the firebox masonry with not less than four 1/2-inch diameter galvanized threaded rod anchors. The threaded rods shall extend upward 1 inch below the top of the concrete beam, shall be embedded 6 inches into masonry at the firebox, and shall be set in cementitious grout.

11. Bond beam. A reinforced concrete beam shall be constructed around the adapter cone, using the cone as the inside form. A minimum 1-1/2-inch cover shall be maintained between the reinforcing steel and the outside face of concrete.

Replace Chimney above Shoulder, Reuse Masonry Firebox

Retrofit of Masonry Chimneys (Plan Set)

Vulnerability-Based Seismic Assessment and Retrofit of Masonry Chimneys

Family Dwellings 1100, Volume 2

Issued: SEPT 2019
1. Masonry firebox. The existing masonry firebox shall remain up to the base of the flue as shown in Detail 2 on Sheet S5.

2. Track or sill plate. Cold-formed steel track sections matching the thickness of the studs shall be provided at the bottom of cold-formed steel chimney chase walls. Wood sill or plate sections having a width not less than the supported studs shall be provided at the bottom of wood chimney chase walls. Wood sill or plate sections shall be protected against decay by the use of naturally durable wood or wood that is preservative-treated. Fastenings in contact with wood sill or plate sections shall be of hot-dipped, zinc-coated galvanized steel or stainless steel. Tracks and sill or plate sections shall be anchored to the concrete beam per Detail 1 on Sheet S5.

3. Chimney chase stud walls. Chimney chases shall be constructed of full height stud walls spaced at no more than 12 inches on center. Stud sizes shall be selected based on story clear height. Wood studs shall not be less than nominal two-by-six or three-by-four inch. Cold-formed steel studs shall not be less than 0.036 inch thickness (18 gauge) by 2.5 inches deep. Cold-formed steel studs shall be completely removed after concrete has cured.

4. Chimney chase connection to dwelling. The chimney chase shall be fastened to the existing residence exterior wall with minimum No. 8 wood screws at 12 inches on center. The chimney chase framing shall be attached to the exterior floor, ceiling and roof framing with not less than two steel straps 1/4-inch wide and minimum 20-mil (0.2-millimeter) minimum in thickness, with each strap located on an opposing face of the chase. Each strap shall be fastened to steel blocking between steel studs of the chimney chase with minimum four No. 8 sheet metal screws, or to wood blocking between wood studs of the chimney chase with not less than four 8d common nails. Each strap shall be fastened to existing steel floor, roof or ceiling framing with minimum No. 8 sheet metal screws, or to existing wood floor, ceiling or roof framing with minimum four 8d common nails. Where chimney chase stud walls extend more than four feet above the highest roof elevation immediately adjacent to the chimney, bracing shall be provided in accordance with this section or in a manner acceptable to the building department. The bracing shall be connected to the chimney chase in the upper third of the chase clear height above the roof (H/3 as shown in Detail 1 on Sheet S2). Not less than two bracing steel angles shall be galvanized or otherwise corrosion resistant and not less than 2-1/2×2–1/2×1/4-inch installed per Detail 2 on Sheet S2. Bracing shall be provided at not less than two locations. The bracing slope shall be not less than 30 degrees and not more than 60 degrees from vertical.

5. Factory-built chimney. Factory-built chimneys shall be sized such that round chimney flues shall have a minimum net cross-sectional area of not less than 1/12 of the fireplace opening. Square chimney flues shall have a minimum net cross-sectional area of 1/10 of the fireplace opening. Rectangular chimney flues with an aspect ratio less than 2:1 shall have a minimum net cross-sectional area of 1/10 of the fireplace opening. Rectangular chimney flues with an aspect ratio of 2:1 or more shall have a minimum net cross-sectional area of 1/8 of the fireplace opening. Factory-built chimneys shall be listed and labeled and shall be installed in accordance with the manufacturer’s instructions. Decorative shrouds shall not be installed at the termination of factory-built chimneys except where the shrouds are listed and labeled for use with this specific factory-built chimney system and installed in accordance with the manufacturer’s instructions. The chimney shall be at an angle of more than 30 degrees (0.52 rad) from vertical at any point in the assembly and the chimney assembly shall not include more than four elbows.

6. Flue cap. Factory-built cap installed in accordance with manufacturer’s instructions and complying with the metal chimney UL listing.

7. Fireblocking. Spaces between chimneys and floors and ceilings through which chimneys pass shall be fireblocked with noncombustible material securely fastened in place. The fireblocking of spaces between chimneys and wood joists, beams or headers shall be self-sealing and installed in accordance with the manufacturer’s instructions. Cold-formed steel studs shall be fastened directly to the wood framing. The fireblocking shall be not less than 4 inches (102 millimeters) in thickness.

8. Chimney cap. A framed chimney cap shall be constructed at the top of the chimney chase. Chimney cap shall be constructed of full height stud walls spaced at no more than 12 inches on center. Stud sizes shall be selected based on story clear height. Cold-formed steel cap sections shall be approved by the manufacturer and shall be installed at the termination of factory-built chimneys except where the shrouds are listed and labeled for use with this specific factory-built chimney system and installed in accordance with the manufacturer’s instructions. Decorative shrouds shall not be installed at the termination of factory-built chimneys except where the shrouds are listed and labeled for use with the specific factory-built chimney system and installed in accordance with the manufacturer’s instructions. No part of the chimney shall be at an angle of more than 30 degrees (0.52 rad) from vertical at any point in the assembly and the chimney assembly shall not include more than four elbows.

9. Chimney cap. A framed chimney cap shall be constructed at the top of the chimney chase. Chimney cap shall be constructed of full height stud walls spaced at no more than 12 inches on center. Stud sizes shall be selected based on story clear height. Cold-formed steel cap sections shall be approved by the manufacturer and shall be installed at the termination of factory-built chimneys except where the shrouds are listed and labeled for use with this specific factory-built chimney system and installed in accordance with the manufacturer’s instructions. Decorative shrouds shall not be installed at the termination of factory-built chimneys except where the shrouds are listed and labeled for use with this specific factory-built chimney system and installed in accordance with the manufacturer’s instructions. No part of the chimney shall be at an angle of more than 30 degrees (0.52 rad) from vertical at any point in the assembly and the chimney assembly shall not include more than four elbows.

10. Chimney chase connection to dwelling. The chimney chase shall be fastened to the existing residence exterior wall with minimum No. 8 wood screws at 12 inches on center. The chimney chase framing shall be attached to the exterior floor, ceiling and roof framing with not less than two steel straps 1/4-inch wide and minimum 20-mil (0.2-millimeter) minimum in thickness, with each strap located on an opposing face of the chase. Each strap shall be fastened to steel blocking between steel studs of the chimney chase with minimum four No. 8 sheet metal screws, or to wood blocking between wood studs of the chimney chase with not less than four 8d common nails. Each strap shall be fastened to existing steel floor, roof or ceiling framing with minimum No. 8 sheet metal screws, or to existing wood floor, ceiling or roof framing with minimum four 8d common nails. Where chimney chase stud walls extend more than four feet above the highest roof elevation immediately adjacent to the chimney, bracing shall be provided in accordance with this section or in a manner acceptable to the building department. The bracing shall be connected to the chimney chase in the upper third of the chase clear height above the roof (H/3 as shown in Detail 1 on Sheet S2). Not less than two bracing steel angles shall be galvanized or otherwise corrosion resistant and not less than 2-1/2×2–1/2×1/4-inch installed per Detail 2 on Sheet S2. Bracing shall be provided at not less than two locations. The bracing slope shall be not less than 30 degrees and not more than 60 degrees from vertical.

11. Factory-built chimney. Factory-built chimneys shall be sized such that round chimney flues shall have a minimum net cross-sectional area of not less than 1/12 of the fireplace opening. Square chimney flues shall have a minimum net cross-sectional area of 1/10 of the fireplace opening. Rectangular chimney flues with an aspect ratio less than 2:1 shall have a minimum net cross-sectional area of 1/10 of the fireplace opening. Rectangular chimney flues with an aspect ratio of 2:1 or more shall have a minimum net cross-sectional area of 1/8 of the fireplace opening. Factory-built chimneys shall be listed and labeled and shall be installed in accordance with the manufacturer’s instructions. Decorative shrouds shall not be installed at the termination of factory-built chimneys except where the shrouds are listed and labeled for use with the specific factory-built chimney system and installed in accordance with the manufacturer’s instructions. No part of the chimney shall be at an angle of more than 30 degrees (0.52 rad) from vertical at any point in the assembly and the chimney assembly shall not include more than four elbows.

12. Flue cap. Factory-built cap installed in accordance with manufacturer’s instructions and complying with the metal chimney UL listing.
All construction shall be in accordance with the factory-built chimney manufacturer’s installation instructions and the following requirements:

1. Track or sill plate. Cold-formed steel track sections matching the thickness of the studs shall be provided at the bottom of cold-formed steel chimney chase walls. Wood sill or sole plates having a width not less than the supported studs shall be provided at the bottom of wood chimney chase walls. Wood sill or sole plates shall be protected against decay by the use of naturally durable wood or wood that is preservative-treated by the supplier. Fasteners in contact with wood sill or sole plates shall be of hot-dipped, zinc-coated galvanized steel or stain-resistant steel. Tracks and sill or sole plates shall be anchored to the concrete base per Detail 1 on Sheet S5.

2. Chimney chase stud walls. Chimney chases shall be constructed of full height stud walls spaced at no more than 12 inches on center. Stud sizes shall be selected based on story clear height. Wood studs shall not be less than nominal 2-inch by 2-inch. Cold-formed steel studs shall be not less than 43 mil thickness (1/8 in) by 2-1/2 inches deep. The top of the chimney chase shall extend not less than three feet above the roof line and not less than 2 feet above the maximum roof elevation, or maximum elevation of other construction located within a 10-foot horizontal distance in any direction from the chimney. Where the exterior walls adjacent to the chase are less than 6 feet from the front line, they shall be constructed with full 2x4 wood or 54 mil (16 in) 5/8-inch steel stud walls with exterior sheathing that includes 7/8-inch thick conventional sheathing or minimum 12-inch thick Type “A” gypsum sheathing. Check with building department for any additional fire code requirements. The chimney chase shall be capped, with roofing and flashing to be weatherproof and to match existing construction.

3. Chimney chase connection to dwelling. The chimney chase shall be fastened to the existing residence exterior wall with minimum No. 8 wood screws at 12 inches on center. The chimney chase framing shall be strapped to the existing floor, ceiling, and roof framing with not less than two steel strap 1-1/4 inch minimum in width and 22 mil (0.022) minimum in thickness, on the opposing faces of the chase. Each strap shall be fastened to steel blocking between steel stud walls of the chimney chase with minimum four No. 8 sheet metal screws, or to wood blocking between studs of the chimney chase with not less than four 1x2 common nails. Where chimney chase stud walls extend more than four feet above the highest roof elevation immediately adjacent to the chimney, bracing shall be provided in accordance with this section. The bracing shall be fastened to the chimney chase in the upper third of the chase clear height above the roof (H3 as shown in Detail 1 on Sheet S2). Not less than two bracing steel angles shall be galvanized or otherwise corrosion resistant and not less than 2-1/2x2-1/2x1-1/2-inch installed per Detail 2 on Sheet S2. Bracing shall be provided at not less than two locations. The bracing angle slope shall be not less than 30 degrees and not more than 60 degrees from vertical.

4. Factory-Built Chimney. Factory-built chimneys shall be per UL 103 (and UL 369 for medium-heat appliances), sized such that round chimney flues shall have a minimum net cross-sectional area of not less than 1/12 of the fireplace opening. Square chimney flues shall have a minimum net cross-sectional area of 1/10 of the fireplace opening. Rectangular chimney flues with an aspect ratio less than 2:1 shall have a minimum net cross-sectional area of 1/8 of the fireplace opening. Factory-built chimneys shall be listed and labeled and shall be installed and terminated in accordance with the manufacturer’s instructions. Decorative shrouds shall not be installed at the termination of factory-built chimneys except where the shrouds are listed and labeled for use with the specific factory-built chimney system and installed in accordance with the manufacturer’s instructions. No part of the chimney shall be at an angle of more than 30 degrees (5.32 rad) from vertical at any point in the assembly and the chimney assembly shall not include more than four elbows.

5. Blower Cap. Factory-built cap installed in accordance with manufacturer’s instructions and complying with the metal chimney UL listing.

6. Fireblocking. Spaces between chimneys and floor and ceiling through which chimneys pass shall be fireblocked with noncombustible material securely fastened in place. The fireblocking of spaces between chimneys and wood joists, beams, or headers shall be self-supporting or be placed on strips of metal or metal lath nailed across the spaces between combustible material and the chimney.

7. Chimney Cap. A framed chimney cap shall be constructed at the top of the chimney chase.

8. Existing Foundation. An existing concrete foundation in good condition shall be permitted to be retained and incorporated. Where the existing foundation is deemed to be in poor condition or constructed of material other than concrete, it shall be removed and replaced in accordance with the fireplace manufacturer and this section. As a minimum, the new footings shall be constructed of concrete not less than 12 inches (305 mm) thick and shall extend not less than 6 inches (152 mm) beyond the face of the fireplace or foundation wall on all sides. Foundations shall be founded on natural, undisturbed earth or engineered fill below frost depth. In areas not subjected to freezing, footings shall be not less than 12 inches (305 mm) below finish grade. Provide 1/2” threaded rod anchor bolt with epoxy anchors embedded not less than 4 inches into existing concrete, minimum three per side. Provide 1/2” anchor bolts with 7 inches minimum embedment into new concrete, minimum three per side.

9. Extension of Existing Foundation. Where required to meet dimensional requirements specified by the fireplace manufacturer or the requirements in #1 above, the existing concrete footing shall be extended as shown in detail. The depth of the new foundation shall match the depth of the existing foundation, but the bottom of the foundation shall not be less than 12 inches below grade. The foundation extension shall be reinforced with one 84” by 8” top and bottom and epoxy dowels into the existing foundation spaced no more than 12 inches on center. Embed 4 inches minimum into existing concrete with epoxy anchors. Provide 1/2” threaded rod anchor bolt with epoxy anchors embedded not less than 4 inches into existing concrete, minimum three per side. Provide 1/2” anchor bolts with 7 inches minimum embedment into new concrete, minimum three per side.

10. Non-combustible Hearth Extension. Where required to meet manufacturer’s requirements or fireplace listing, a hearth extension listed and labeled per UL 1618 shall be provided.

11. Factory-built Fireplace. Factory-built fireplaces shall be listed and labeled and shall be installed per the conditions of the listing.

12. Existing Framing. Existing roof, wall, and ceiling framing shall remain. Where existing wall framing requires modification to accommodate a new fireplace opening, it shall be verified to be in good condition and in accordance with conventional construction provisions. New framing shall match existing construction.

INSTRUCTIONS FOR USE

A. Before you begin:

1. This plan set is intended for use by a general contractor or homeowner without necessarily having to involve a registered design professional.
2. Contact your local building department to understand the building permit application process. Ask about:
   a. Fees.
   b. How many copies of the plan must be submitted, and
   c. Which city inspections are required.
3. The Building Official may also be able to assist with assessing the applicability of this plan set to a home. See Eligibility For Use, Sheet S0, Table 1.
4. Complete the Eligibility For Use questionnaire on Sheet S0 to determine if this plan set is applicable. A "non-compliant" answer to any question disqualifies the home from using this plan set.

B. Prepare your plan set:

1. Draw a scaled plan of the home in the space provided on Sheet S0, Detail 1. Your plan should include the following:
   a. The general outline of the home. It is helpful to draw roof ridges, hips and valleys.
   b. The front (street) side of the home and the back side of the home.
   c. A north arrow.
   d. The location of the chimney to be retrofitted.
   e. Chimney dimensions “A,” “B,” “C,” and “H” as shown in Detail 3 on Sheet S2.
   f. See Sheet S1 for an example plan.
2. Gather information to complete the plan set:
   a. Review general notes on Sheet S1 for guidance on materials and installation for the required work.
   b. Use Table 2 on Sheet S0 to determine which retrofit methods are applicable to your home and chimney.
   c. If several retrofit methods are applicable, choose the preferred method, and identify the sheet that gives applicable detailing (choose one of Sheets S3 through S6).
   d. Determine whether Details 1 and 2 on Sheet S2 are required (based on Note 4 on Sheet S4 or S5, or Note 3 on Sheet S6).
3. Complete your plans:
   a. If none of Details 1 and 2 on Sheet S2 are required, note that on the Sheet S0 plan and provide a reference to the details.
   b. Submit your plans to the building department:
      1. The submitted plan set should always include Sheets S0 and S1. If Details 1 and 2 on Sheet S2 are to be used, the submitted plan set should also include Sheet S2. Finally, also include the one sheet that is to be used for the chimney retrofit (include one only of Sheets S3 through S6; do not submit sheets that are not being used).
      2. Submit a permit application and the required number of complete plan sets to the building department for review. Photographs of the chimney to be retrofitted may assist the review process.
      3. Before beginning work, the permit holder may be required to schedule an inspection with the building department to verify that field conditions are consistent with the information provided on the approved plans.
      4. Inspectors by the building department during the retrofit work may be required:
         a. Foundation and masonry prior to placing concrete
         b. Foundation anchor bolts
         c. Anchorage to existing masonry and adaptor cone installation
         d. Finishing
         e. Fire blocking
         f. See Sheet X1 for an example plan.

4. Complete the Eligibility For Use questionnaire on Sheet S0 to determine if this plan set is applicable. A "non-compliant" answer to any question disqualifies the home from using this plan set.

PURPOSE

The purpose of this plan set is to promote public safety and welfare by reducing earthquake-induced damage to existing masonry chimneys. The provisions of this plan set address a single vulnerability - falling hazards associated with masonry chimneys. Eligible chimneys retrofitted to the prescriptive designs provided in this plan set are considered to comply with the requirements of Chapter 7 of FEMA P-1100. Construction details of this plan set are intended to improve the performance of chimneys, but may not prevent their damage or collapse in earthquake shaking.

SCOPE

This plan set contains prescriptive provisions for retrofit of masonry chimneys of one- and two-family, light-frame detached dwellings of three stories or less. Considerations and methods beyond those in this plan set may be appropriate for dwellings listed in or eligible for listing in the National Register of Historic Places, or designated as historic under an appropriate state or local law.

ELIGIBILITY

Chimneys must meet all of the requirements of Table 1 on Sheet S0 to be eligible for the retrofit provisions of this plan set. Chimneys not eligible for this plan set can be retrofitted in accordance with FEMA P-1100, Chapter 7.

ASSESSMENT

The retrofit provisions of this plan set are intended to apply to chimneys that have been assessed using the FEMA P-1100 Prestandard methodology and found to have a masonry chimney vulnerability.

Table 1: ELIGIBILITY FOR USE

<table>
<thead>
<tr>
<th>Chimney Location</th>
<th>Chimney Height</th>
<th>Unbraced Portion</th>
<th>Minimum Requirements for Compliance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exterior</td>
<td>Any</td>
<td>Two or Three Stories</td>
<td>Demolish down to base (shoulder) of the chimney at the lowest fire box.</td>
</tr>
<tr>
<td>Interior</td>
<td>One Story</td>
<td>Some portion of the chimney is freestanding (not in contact with a wall on any of the four sides) for a height of more than six feet.</td>
<td>Demolish to floor or ceiling directly below unbraced portion.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>S3 Details 1 or S3 Details 2 or S4, S5, or S6</td>
</tr>
</tbody>
</table>

Table 2: DETERMINATION OF RETROFIT SCOPE

Use this table to determine which retrofit in Sheets S3 to S6 is permitted for the home. See Detail 3 on Sheet S2 for definitions of dimensions B and H.

<table>
<thead>
<tr>
<th>Chimney Location</th>
<th>Chimney Height</th>
<th>Unbraced Portion</th>
<th>Minimum Requirements for Compliance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exterior</td>
<td>Any</td>
<td>Two or Three Stories</td>
<td>Demolish down to base (shoulder) of the chimney at the lowest fire box.</td>
</tr>
<tr>
<td>Interior</td>
<td>One Story</td>
<td>Some portion of the chimney is freestanding (not in contact with a wall on any of the four sides) for a height of more than six feet.</td>
<td>Demolish to floor or ceiling directly below unbraced portion.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>S3 Details 1 or S3 Details 2 or S4, S5, or S6</td>
</tr>
</tbody>
</table>