

SCOPE

- I 1.1 This practice covers the design, construction and inspection of reinforced concrete chimneys.
- I 1.2 **An asterisk (*)** indicates that a decision by the Owner is required or that additional information is furnished by the Owner.

SUMMARY OF ADDITIONAL REQUIREMENTS

- I ↗ 2.1 **Table 1** lists the practices and standards which shall be used with this practice as specified.

TABLE 1

PRACTICES	
IP 4-1-1	Concrete Design and Construction
IP 4-6-1	Reinforced Concrete Foundations and Anchor Bolts
STANDARDS	
ACI Standards	
211.1	Recommended Practice for Selecting Proportions for Normal and Heavyweight Concrete
301	Specifications for Structural Concrete for Buildings
307	Specification for the Design and Construction of Reinforced Concrete Chimneys
ANSI Standards	
A14.3	Safety Code for Fixed Ladders
C5.1	Lightning Protection Code

- I 2.2 **Table 2** lists the practices, standards and publication which shall be used with this practice as applicable.

TABLE 2

PRACTICES	
IP 4-7-1	Piles and Sheet Piling
IP 14-1-1	External Insulation
IP 19-3-3	Linings for Fired Heaters
STANDARDS AND PUBLICATION	
ASTM Standards	
C64	Refractories for Incinerators and Boilers
CICIND (International Committee on Industrial Chimneys) Publication	
Model Code for Concrete Chimneys	
Part B	Brickwork Linings
Part C	Steel Liners

- I 2.3 **If local codes or standards exist** for the materials, design, and test methods covered in **Table 1** and **Table 2** which yield comparable quality, they may be substituted if approved by Owner's Engineer.

DOCUMENTATION

PROPOSAL INFORMATION

- I *3.1 **An outline drawing** shall be provided, showing the chimney and foundation diameters, height, taper, flue arrangement, location and size of openings. The drawing shall also include a data sheet listing anticipated concentration of sulphur in the fuel burned and maximum and minimum gas exit velocities; gas temperatures at each duct entry and gas exit temperatures. This data shall relate to both normal and abnormal operating conditions.
- I 3.2 **Complete material specifications** shall be provided for the shell, flue, insulation, accessories, and the foundation.

IP 4-5-2	Reinforced Concrete Chimneys	
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CONSTRUCTION DRAWINGS AND CALCULATIONS

- I ♦ 3.3 **Copies of all computations on which design drawings are based** shall be furnished. **Construction drawings** shall show details of the shell, flue, insulation accessories, and foundation. The minimum and maximum temperatures for which the various components are designed shall also be shown.

MATERIALS

- I * 4.1 **Proposals to use concrete admixtures** shall be submitted for approval by the Owner's Engineer.
- R 4.2 **Materials for use in acid resisting brickwork** shall comply with the requirements of the CICIND Model Code for concrete chimneys, Part B - Brickwork Linings. When acid resistant coatings are required for the inner surfaces of steel liners, hydraulic setting castable containing a catalyzed sodium silicate cement (Sauerseisen No. 33, 54, or 72 cements) or demonstrated equal shall be used.
- R 4.3 Hastalloy, Type 316L stainless steel, silicon bronze, or lead-sheathed carbon steel shall be used for the following applications:
- Anchor bolts** for ladders, platforms and scaffold supports exposed to flue gases.
 - All external hardware** which may be in contact with flue gases (e.g., within 5 diameters of the top of the chimney).

DESIGN

- R ♦ 5.1 **Cast-in-place reinforced concrete chimneys** shall be designed and constructed per ACI 307 unless otherwise specified.
- R ♦ * 5.2 The seismic risk zone for **earthquake loads** will be specified. The specified design wind speed or 80 mph (36 m/s), whichever is greater, with an Importance Factor, I, of 1.0 shall be used for **wind loads**.
- I 5.3 **Thermal stresses** shall be determined for the shell and the flue, using the largest anticipated temperature differential, including startup, shutdown, normal and abnormal operating conditions.
- I 5.4 **Stresses shall be determined** at the base, at levels of openings, and at 10 or more regular intervals along the height of the chimney.
- I 5.5 **Foundation design** shall be per **IP 4-6-1**. The relevant "Design overturning moment" relates to unfactored loads. For chimneys taller than 300 ft (90 m), the entire chimney foundation must remain in compression when the completed chimney is subjected to the design overturning moment, regardless of soil type.
- I 5.6 **Foundations and elevated floors which support the flue** shall not be directly exposed to hot flue gases. Sufficient insulation, vents, drains, coatings and flashing shall be provided to control concrete temperatures and minimize corrosion.
- R 5.7 **Minimum airspace width** for chimneys with free-standing brickwork flues shall be 8 in. (200 mm) for chimneys of heights up to 200 ft (60 m). An additional 3 in. (75 mm) clearance shall be provided for each additional 100 ft (30 m) height. A 30 in. (750 mm) minimum clearance shall be provided when inspection capability is specified.
- I 5.8 **Lightning protection** shall be provided per ANSI C5.1.
- R 5.9 Special care shall be taken to ensure the long term integrity of all **items attached externally to the shell** or to exposed parts of the flue. Such items include **insulation protection, rainshields, lightning conductor rods, aircraft warning lights, ladders and platforms**. In their design and the design of their attachments, the effects of stress corrosion and fatigue damage, due to wind "Flutter," shall be considered. Rainshields protecting the annular airspace shall not be attached to the flue.
- I 5.10 When a **Flue Gas Desulfurization (FGD) or energy conservation system** involves cooling flue gas below its acid dew point, followed by reheat, achieved by **mixing** with by-passed flue gas, the mixing shall be accomplished upstream of the stack.

BRICK FLUES

- R 5.11 **Acid-resisting brickwork flues** shall be used in stacks serving units equipped with Flue Gas Desulfurization systems, or if the sulfur content of the fuel fired exceeds 0.5 mass % (flue gas sulfur concentrations 17 grains per 100 scf or 400 mg/m³ are considered equivalent for this purpose) and the hot face temperature of any part of the flue is less than 350°F (175°C).
- I 5.12 **Independent brick flues** shall have a minimum thickness of 8 in. (200 mm).

