A111.4.4 Collectors. An analysis of diaphragm collector forces shall be made for the transfer of diaphragm edge shears into vertical elements of the lateral-force-resisting system. Collector forces may be resisted by new or existing elements.

A111.4.5 Diaphragm openings.

1. Diaphragm forces at corners of openings shall be investigated and shall be developed into the diaphragm by new or existing materials.
2. In addition to the demand-capacity ratios of Section A111.4.2, the demand-capacity ratio of the portion of the diaphragm adjacent to an opening shall be calculated using the opening dimension as the span.
3. Where an opening occurs in the end quarter of the diaphragm span, the calculation of $v_u D$ for the demand-capacity ratio shall be based on the net depth of the diaphragm.

A111.5 Diaphragm shear transfer. Diaphragms shall be connected to shear walls with connections capable of developing the diaphragm-loading tributary to the shear wall given by the lesser of the following formulas:

$$V = 1.2 S_{D1} C_p W_d$$ **(Equation A1-13)**

using the C_p values in Table A1-C, or

$$V = v_u D$$ **(Equation A1-14)**

A111.6 Shear walls (In-plane loading).

A111.6.1 Wall story force. The wall story force distributed to a shear wall at any diaphragm level shall be the lesser value calculated as:

$$F_{wx} = 0.8 S_{D1}(W_{wx} + W_d/2)$$ **(Equation A1-15)**

but need not exceed

$$F_{wx} = 0.8 S_{D1} W_{wx} + v_u D$$ **(Equation A1-16)**

A111.6.2 Wall story shear. The wall story shear shall be the sum of the wall story forces at and above the level of consideration.

$$V_{wx} = \Sigma F_{wx}$$ **(Equation A1-17)**

A111.6.3 Shear wall analysis. Shear walls shall comply with Section A112.

A111.6.4 Moment frames. Moment frames used in place of shear walls shall be designed as required by the building code, except that the forces shall be as specified in Section A111.6.1, and the story drift ratio shall be limited to 0.015, except as further limited by Section A112.4.2.

A111.7 Out-of-plane forces—unreinforced masonry walls.

A111.7.1 Allowable unreinforced masonry wall height-to-thickness ratios. The provisions of Section A110.2 are applicable, except the allowable height-to-thickness ratios given in Table A1-B shall be determined from Figure A1-1 as follows:

1. In Region 1, height-to-thickness ratios for buildings with crosswalls may be used if qualifying crosswalls are present in all stories.
2. In Region 2, height-to-thickness ratios for buildings with crosswalls may be used whether or not qualifying crosswalls are present.
3. In Region 3, height-to-thickness ratios for "all other buildings" shall be used whether or not qualifying crosswalls are present.

A111.7.2 Walls with diaphragms in different regions. When diaphragms above and below the wall under consideration have demand-capacity ratios in different regions of Figure A1-1, the lesser height-to-thickness ratio shall be used.

A111.8 Open-front design procedure. A single-story building with an open front on one side and crosswalls parallel to the open front may be designed by the following procedure:

1. Effective diaphragm span, L_i, for use in Figure A1-1 shall be determined in accordance with the following formula:

   $$L_i = 2[(W_w / W_d)L + L]$$ **(Equation A1-18)**

2. Diaphragm demand-capacity ratio shall be calculated as:

   $$DCR = 2.12 S_{D1}(W_d + W_w)/[(v_u D) + V_{cb}]$$ **(Equation A1-19)**

SECTION A112 ANALYSIS AND DESIGN

A112.1 General. The following requirements are applicable to both the general procedure and the special procedure for analyzing vertical elements of the lateral-force-resisting system.

A112.2 Existing unreinforced masonry walls.

A112.2.1 Flexural rigidity. Flexural components of deflection may be neglected in determining the rigidity of an unreinforced masonry wall.

A112.2.2 Shear walls with openings. Wall piers shall be analyzed according to the following procedure, which is diagramed in Figure A1-2.

1. For any pier,

   1.1. The pier shear capacity shall be calculated as:

   $$V_a = v_m A / 1.5$$ **(Equation A1-20)**

   1.2. The pier rocking shear capacity shall be calculated as:

   $$V_r = 0.9 P_D D/H$$ **(Equation A1-21)**

2. The wall piers at any level are acceptable if they comply with one of the following modes of behavior:

   2.1. **Rocking controlled mode.** When the pier rocking shear capacity is less than the pier shear capacity, i.e., $V_r < V_a$ for each pier in a level, forces in the wall at that level, V_{wx}, shall be distributed to each pier in proportion to $P_D D/H$.
   For the wall at that level:

   $$0.7 V_{wx} < \Sigma V_r$$ **(Equation A1-22)**