CODE

(a) Length between the end of a collector and location at which transfer of load to a vertical element begins
(b) Length between two vertical elements

18.12.7.6 Collector elements with compressive stresses exceeding $\mathbf{0.2}f_c'$ at any section shall have transverse reinforcement satisfying 18.7.5.2(a) through (e) and 18.7.5.3, except the spacing limit of 18.7.5.3(a) shall be one-third of the least dimension of the collector. The amount of transverse reinforcement shall be in accordance with Table 18.12.7.6. The specified transverse reinforcement is permitted to be discontinued at a section where the calculated compressive stress is less than $\mathbf{0.15}f_c'$.

If design forces have been amplified to account for the overstrength of the vertical elements of the seismic-force-resisting system, the limit of $\mathbf{0.2}f_c'$ shall be increased to $\mathbf{0.5}f_c'$, and the limit of $\mathbf{0.15}f_c'$ shall be increased to $\mathbf{0.4}f_c'$.

Table 18.12.7.6—Transverse reinforcement for collector elements

Transverse reinforcement	Applicable expressions		
A_{sh}/sb_c for rectilinear hoop	$0.09\frac{f_c'}{f_{yt}}$		(a)
ρ_s for spiral or circular hoop	Greater of:	$0.45\left(\frac{A_g}{A_{ch}}-1\right)\frac{f_c'}{f_{yt}}$	(b)
		$0.12\frac{f_c'}{f_{yt}}$	(c)

18.12.7.7 Longitudinal reinforcement detailing for collector elements at splices and anchorage zones shall satisfy (a) or (b):

(a) Center-to-center spacing of at least three longitudinal bar diameters, but not less than 40 mm, and concrete clear cover of at least two and one-half longitudinal bar diameters, but not less than 50 mm.
(b) Area of transverse reinforcement, providing A_v at least the greater of $\mathbf{0.062}\sqrt{f_c'}(b_w s/f_{yt})$ and $\mathbf{0.35}b_w s/f_{yt}$, except as required in 18.12.7.6

18.12.8 *Flexural strength*

18.12.8.1 Diaphragms and portions of diaphragms shall be designed for flexure in accordance with Chapter 12. The effects of openings shall be considered.

COMMENTARY

designed for f_y of 420 MPa even if Grade 550 reinforcement is specified.

R18.12.7.6 In documents such as the NEHRP Provisions (FEMA P750), ASCE/SEI 7, the 2018 IBC, and the Uniform Building Code (ICBO 1997), collector elements of diaphragms are designed for forces amplified by a factor Ω_o to account for the overstrength in the vertical elements of the seismic-force-resisting systems. The amplification factor Ω_o ranges between 2 and 3 for most concrete structures, depending on the document selected and on the type of seismic-force-resisting system. In some documents, the factor can be calculated based on the maximum forces that can be developed by the elements of the vertical seismic-force-resisting system.

Compressive stress calculated for the factored forces on a linearly elastic model based on gross section of the structural diaphragm is used as an index value to determine whether confining reinforcement is required. A calculated compressive stress of $\mathbf{0.2}f_c'$, or $\mathbf{0.5}f_c'$ for forces amplified by Ω_o, is assumed to indicate that integrity of the entire structure depends on the ability of that member to resist substantial compressive force under severe cyclic loading. Transverse reinforcement is required at such locations to provide confinement for the concrete and the reinforcement.

R18.12.7.7 This section is intended to reduce the possibility of bar buckling and provide adequate bar development conditions in the vicinity of splices and anchorage zones.

R18.12.8 *Flexural strength*

R18.12.8.1 Flexural strength for diaphragms is calculated using the same assumptions as for walls, columns, or beams. The design of diaphragms for flexure and other actions uses the applicable load combinations of 5.3.1 to consider earthquake forces acting concurrently with gravity or other loads.

The influence of slab openings on flexural and shear strength is to be considered, including evaluating the potential critical sections created by the openings. The strut-and-tie method is potentially useful for designing diaphragms with openings.