

For pile-supported piers, wharves, and platforms where containers are stacked on the structure, the effects of the stacked containers on the seismic mass of the structure shall be considered.

3.8 OTHER DESIGN CONSIDERATIONS

3.8.1 Capacity Protection The deck shall be designed as a capacity-protected element, such that all inelastic deformations occur in piles rather than in the deck elements. Yielding of the pile-to-deck connection is permitted.

Exception: Strain penetration of the pile connection dowels in the deck is permitted.

3.9 STRAIN LIMITS

The maximum plastic hinge zone strains for the operating level earthquake (OLE), contingency level earthquake (CLE), and design earthquake (DE) performance levels (as defined in Table 2-1) shall be calculated per Section 6.6.3 using the moment–curvature methods described in conjunction with the plastic hinge lengths provided in Table 6-1 and compared to the strain limits provided in this section.

3.9.1 OLE Strain Limits Table 3-1 provides the maximum material strains allowed within the performance level of “minimal damage” as per Section 2.4.3.

3.9.2 CLE Strain Limits Table 3-2 provides the maximum material strains within the performance level of “controlled and repairable damage” as per Section 2.4.2.

3.9.3 DE Strain Limits Table 3-3 provides the maximum material strains allowed within the performance level of “life safety protection” as per Section 2.4.1.

Concrete piles are also subject to the DE stability check in Section 3.10. Steel piles are subject to the DE stability check in Section 3.10.

Pile connections at the top of a pile may have additional requirements and limitations depending on the type of connection, as per Chapter 7.

Table 3-1. Strain Limits for “Minimal Damage” per Section 2.4.3

Pile type	Component	Hinge location		
		Top of pile	In ground	Deep in ground (>10D _p)
Solid concrete pile	Concrete	$\epsilon_c \leq 0.005$	$\epsilon_c \leq 0.005$	$\epsilon_c \leq 0.008$
	Reinforcing steel	$\epsilon_s \leq 0.015$		
	Prestressing steel		$\epsilon_p \leq 0.015$	$\epsilon_p \leq 0.015$
Hollow concrete pile ^a	Concrete	$\epsilon_c \leq 0.004$	$\epsilon_c \leq 0.004$	$\epsilon_c \leq 0.004$
	Reinforcing steel	$\epsilon_s \leq 0.015$		
	Prestressing steel		$\epsilon_p \leq 0.015$	$\epsilon_p \leq 0.015$
Steel pipe pile	Steel pipe		$\epsilon_s \leq 0.010$	$\epsilon_s \leq 0.010$
	Concrete	$\epsilon_c \leq 0.010$		
	Reinforcing steel	$\epsilon_s \leq 0.015$		

^aIf the interior of the hollow pile is filled with concrete, all strain limits shall be the same as for solid piles.

3.10 DESIGN EARTHQUAKE STABILITY CHECK

The DE stability check shall be performed per Section 6.6.7, with the following modifications. All pile-to-deck connections with a reinforcement strain greater than 0.06 shall be assumed to be pinned at the top for the DE stability check. In addition, the strain limits in Table 3-3 shall not be exceeded.

Table 3-2. Strain Limits for “Controlled and Repairable Damage” per Section 2.4.2

Pile type	Component	Hinge location		
		Top of pile	In ground	Deep in ground (>10D _p)
Solid concrete pile	Concrete	$\epsilon_c \leq 0.005 + 1.1\rho_s \leq 0.025$	$\epsilon_c \leq 0.005 + 1.1\rho_s \leq 0.008$	$\epsilon_c \leq 0.012$
	Reinforcing steel	$\epsilon_s \leq 0.6\epsilon_{smd} \leq 0.06$		
	Prestressing steel		$\epsilon_p \leq 0.025$	$\epsilon_p \leq 0.025$
Hollow concrete pile ^a	Concrete	$\epsilon_c \leq 0.006$	$\epsilon_c \leq 0.006$	$\epsilon_c \leq 0.006$
	Reinforcing steel	$\epsilon_s \leq 0.4\epsilon_{smd} \leq 0.04$		
	Prestressing steel		$\epsilon_p \leq 0.020$	$\epsilon_p \leq 0.025$
Steel pipe pile	Steel pipe		$\epsilon_s \leq 0.025^b$	$\epsilon_s \leq 0.035$
	Concrete	$\epsilon_c \leq 0.025$		
	Reinforcing steel	$\epsilon_s \leq 0.6\epsilon_{smd} \leq 0.06$		

^aIf the interior of the hollow pile is filled with concrete, all strain limits shall be the same as for solid piles.

^bIf the steel pipe pile is infilled with concrete, a value of 0.035 may be used.

Table 3-3. Strain Limits for “Life Safety Protection” per Section 2.4.1

Pile type	Component	Hinge location		
		Top of pile	In ground	Deep in ground (>10D _p)
Solid concrete pile	Concrete	No limit	$\epsilon_c \leq 0.005 + 1.1\rho_s \leq 0.012$	No limit
	Reinforcing steel	$\epsilon_s \leq 0.8\epsilon_{smd} \leq 0.08$		
	Prestressing steel		$\epsilon_p \leq 0.035$	$\epsilon_p \leq 0.050$
Hollow concrete pile ^a	Concrete	$\epsilon_c \leq 0.008$	$\epsilon_c \leq 0.008$	$\epsilon_c \leq 0.008$
	Reinforcing steel	$\epsilon_s \leq 0.6\epsilon_{smd} \leq 0.06$		
	Prestressing steel		$\epsilon_p \leq 0.025$	$\epsilon_p \leq 0.050$
Steel pipe pile	Steel pipe		$\epsilon_s \leq 0.035^b$	$\epsilon_s \leq 0.050$
	Concrete	No limit		
	Reinforcing steel	$\epsilon_s \leq 0.8\epsilon_{smd} \leq 0.08$		

^aIf the interior of the hollow pile is filled with concrete, all strain limits shall be the same as for solid piles.

^bIf the steel pipe pile is infilled with concrete, a value of 0.050 may be used.