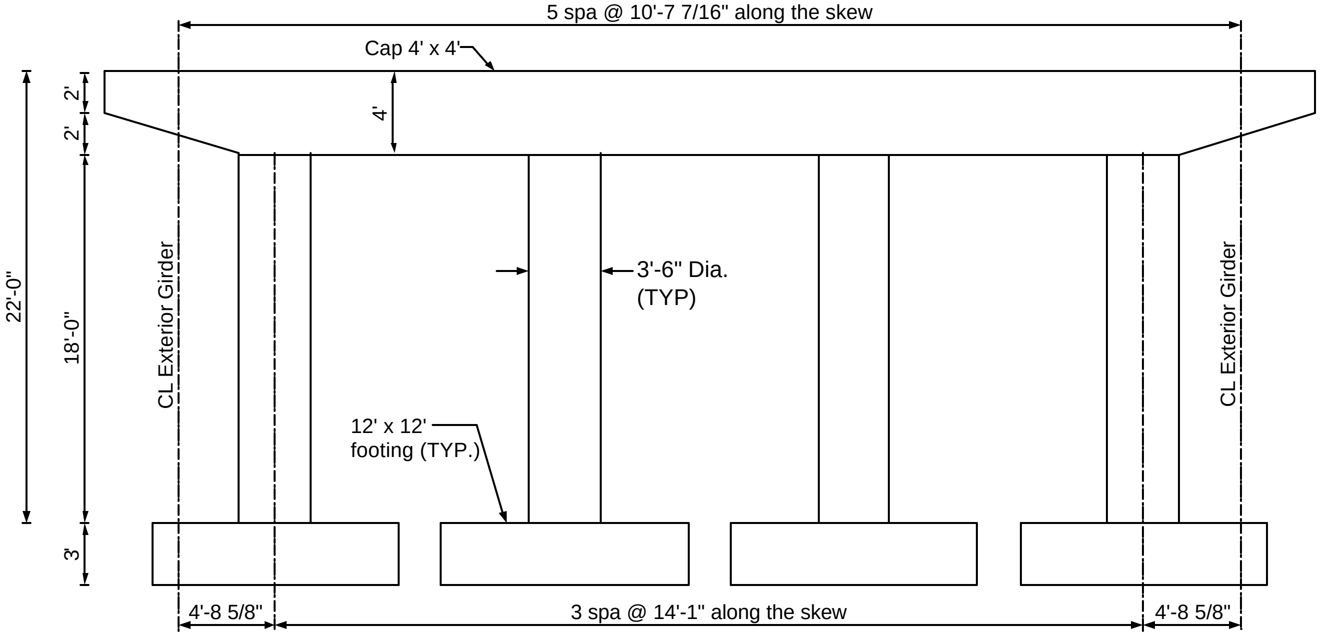


Figure 2-7 – Intermediate Bent

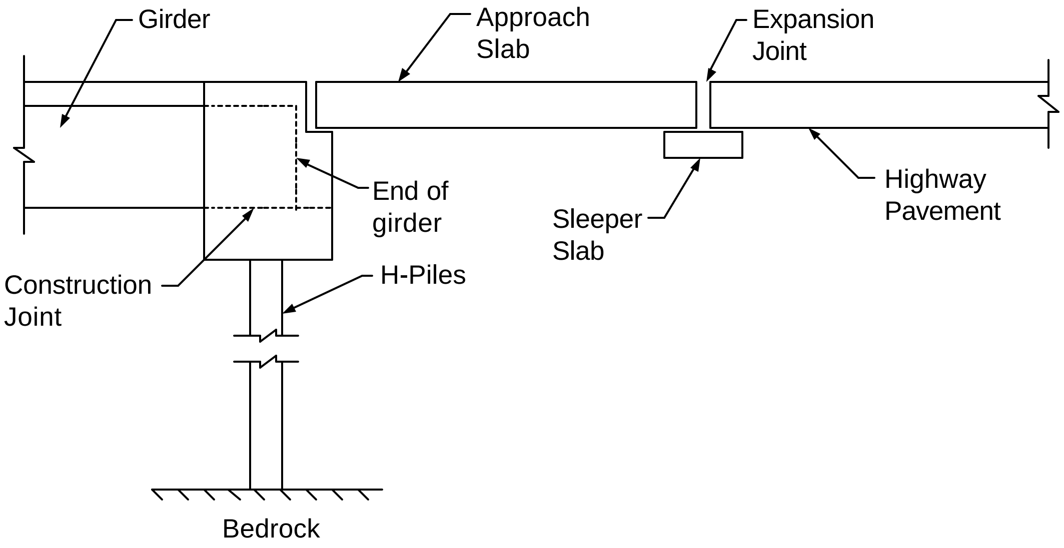


Figure 2-8 – Integral Abutment

2.3 Effective flange width (S4.6.2.6)

Longitudinal stresses in the flanges are distributed across the flange and the composite deck slab by in-plane shear stresses, therefore, the longitudinal stresses are not uniform. The effective flange width is a reduced width over which the longitudinal stresses are assumed to be uniformly distributed and yet result in the same force as the non-uniform stress distribution if integrated over the entire width.

The effective flange width is calculated using the provisions of S4.6.2.6. See the bulleted list at the end of this section for a few S4.6.2.6 requirements. According to S4.6.2.6.1, the effective flange width may be calculated as follows:

For interior girders:
The effective flange width is taken as the least of the following:

- One-quarter of the effective span length = 0.25(82.5)(12)
  = 247.5 in.

- 12.0 times the average thickness of the slab,
  plus the greater of the web thickness = 12(7.5) + 8 = 104 in.
  or
  one-half the width of the top flange of the girder = 12(7.5) + 0.5(42)
  = 111 in.

- The average spacing of adjacent beams = 9 ft.- 8 in. or 116 in.

The effective flange width for the interior beam is 111 in.

For exterior girders:
The effective flange width is taken as one-half the effective width of the adjacent interior girder *plus* the least of:

- One-eighth of the effective span length = 0.125(82.5)(12)
  = 123.75 in.

- 6.0 times the average thickness of the slab,
  plus the greater of half the web thickness = 6.0(7.5) + 0.5(8)
  = 49 in.

  or
  one-quarter of the width of the top flange
  of the basic girder = 6.0(7.5) + 0.25(42)
  = 55.5 in.

- The width of the overhang = 3 ft.- 6 ¼ in. or 42.25 in.

Therefore, the effective flange width for the exterior girder is:

(111/2) + 42.25 = 97.75 in.

Notice that:

- *The effective span length used in calculating the effective flange width may be taken as the actual span length for simply supported spans or as the distance between points of permanent dead load inflection for continuous spans, as specified in S4.6.2.6.1. For analysis of I-shaped girders, the effective flange width is typically calculated based on the effective span for positive moments and is used along the entire length of the beam.*

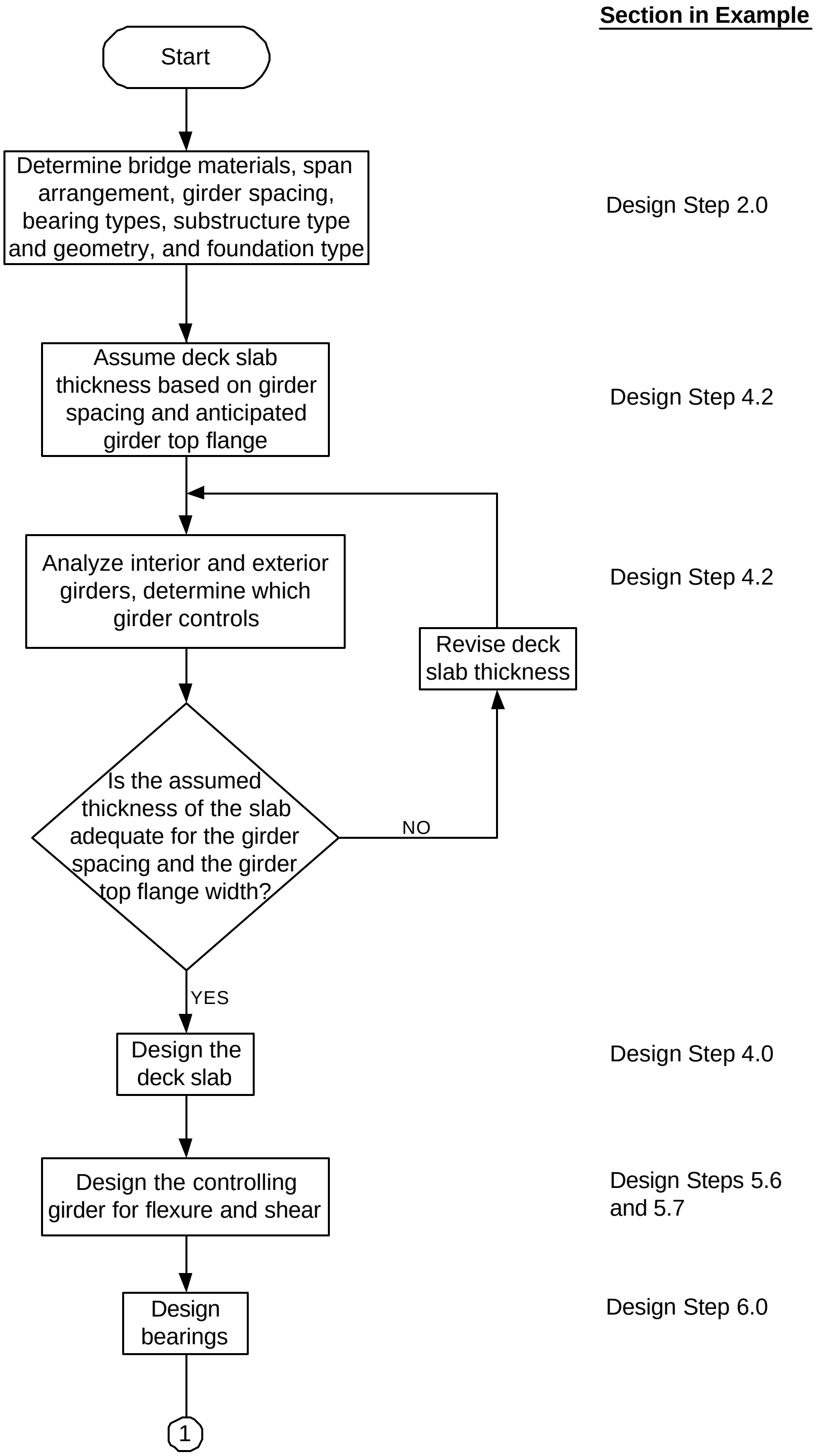
- *The slab thickness used in the analysis is the effective slab thickness ignoring any sacrificial layers (i.e., integral wearing surfaces)*

- *S4.5 allows the consideration of continuous barriers when analyzing for service and fatigue limit states. The commentary of S4.6.2.6.1 includes an approximate method of including the effect of the continuous barriers on the section by modifying the width of the overhang. Traditionally, the effect of the continuous barrier on the section is ignored in the design of new bridges and is ignored in this example. This effect may be considered when checking existing bridges with structurally sound continuous barriers.*

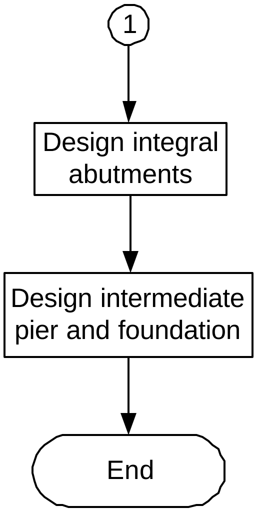
- *Simple-span girders made continuous behave as continuous beams for all loads applied after the deck slab hardens. For two-equal span girders, the effective length of each span, measured as the distance from the center of the end support to the inflection point for composite dead loads (load is assumed to be distributed uniformly along the length of the girders), is 0.75 the length of the span.*

3. FLOWCHARTS

Main Design Steps



Main Design Steps (cont.)

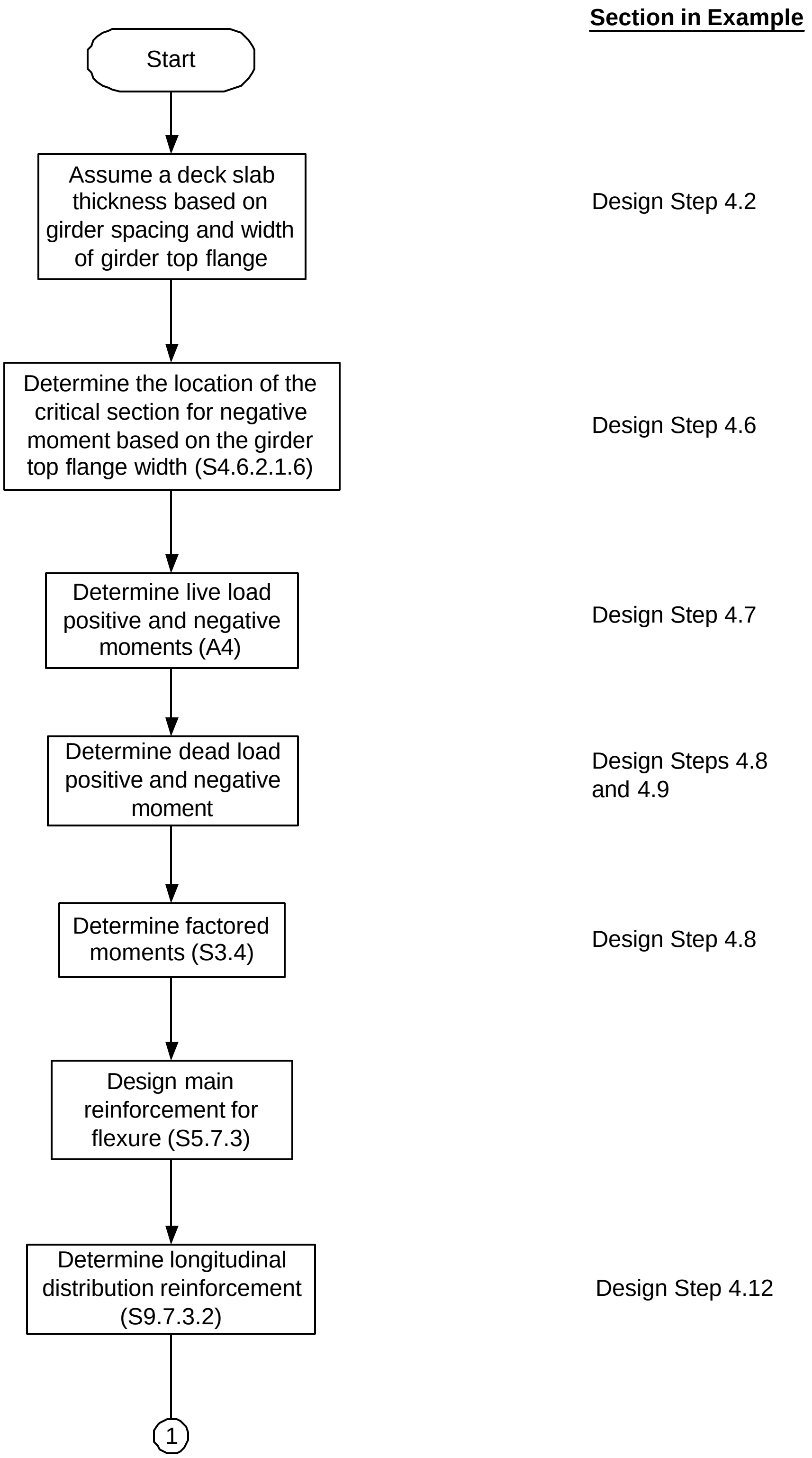


Section in Example

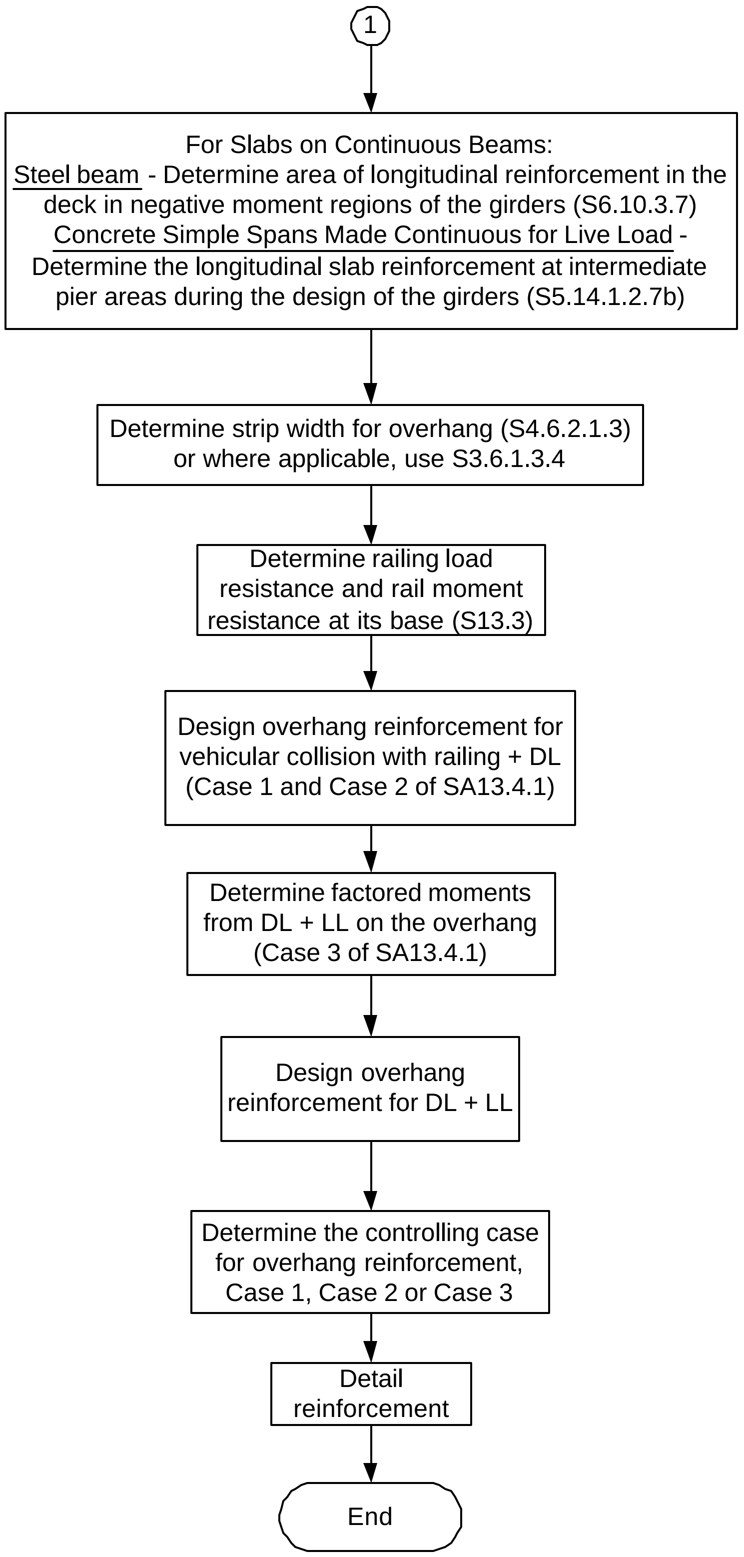
Design Step 7.1

Design Step 7.2

Deck Slab Design



Deck Slab Design (cont.)



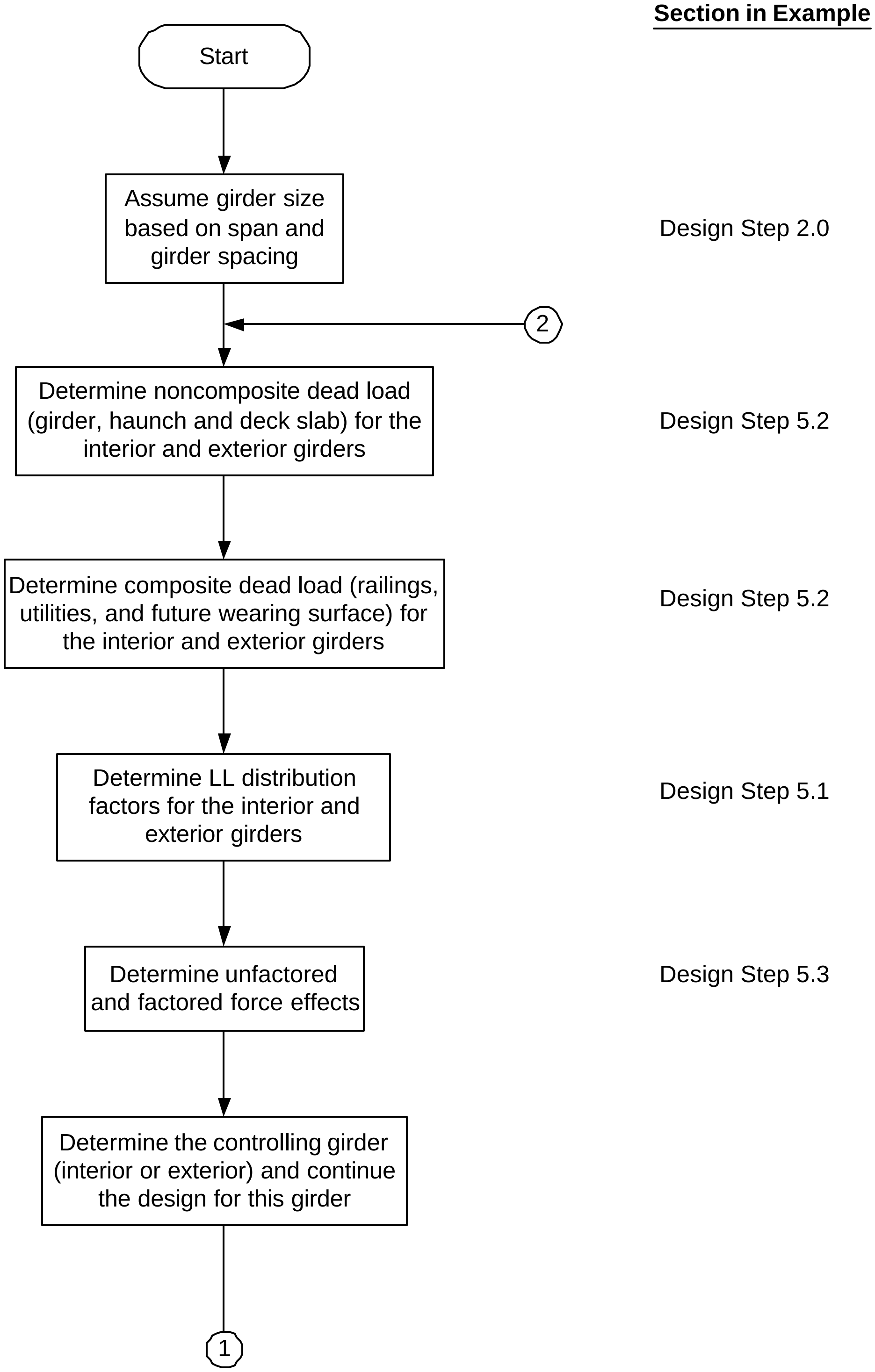
Section in Example

Design Step 4.10

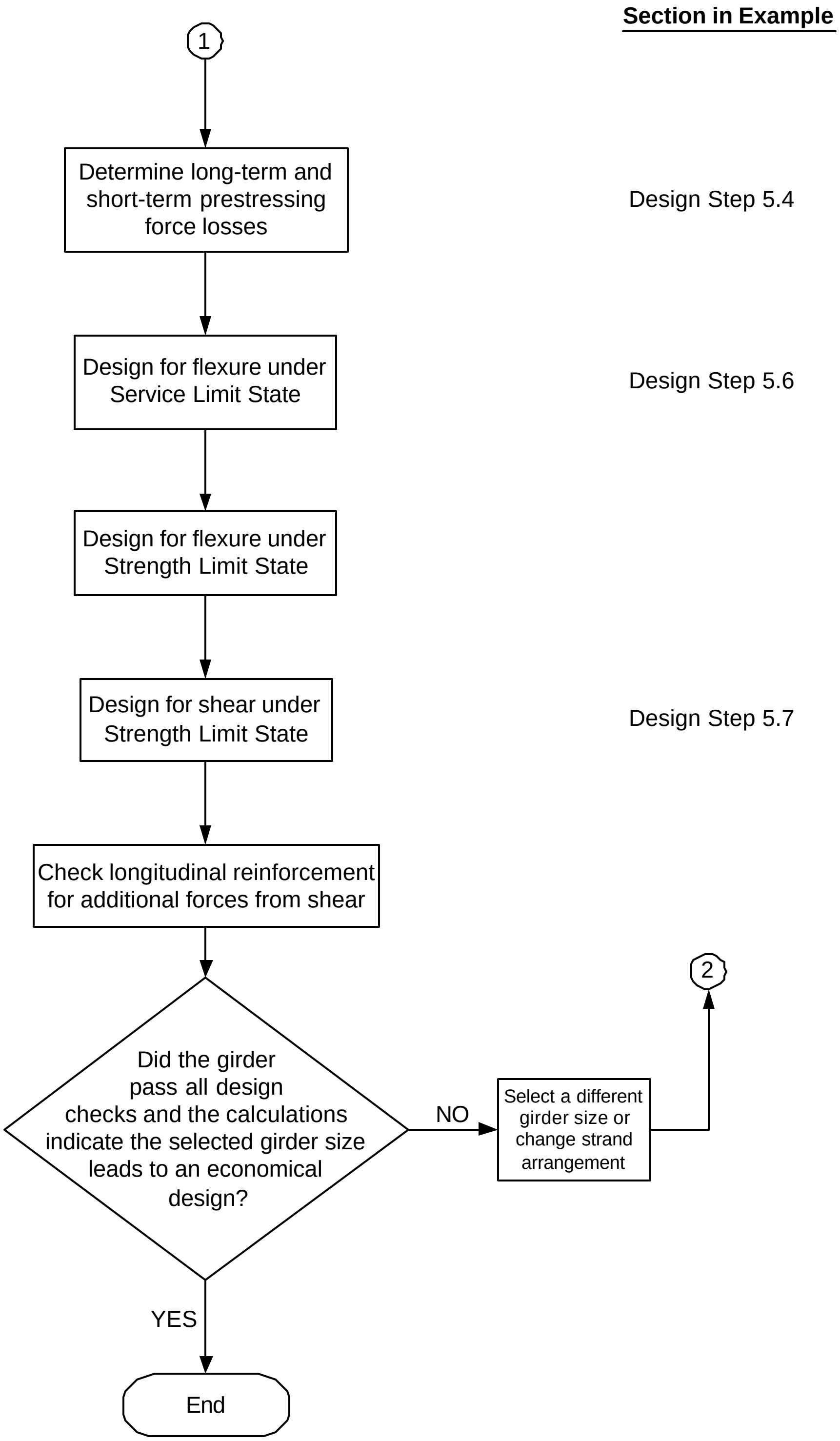
Design Step 4.11

General Superstructure Design

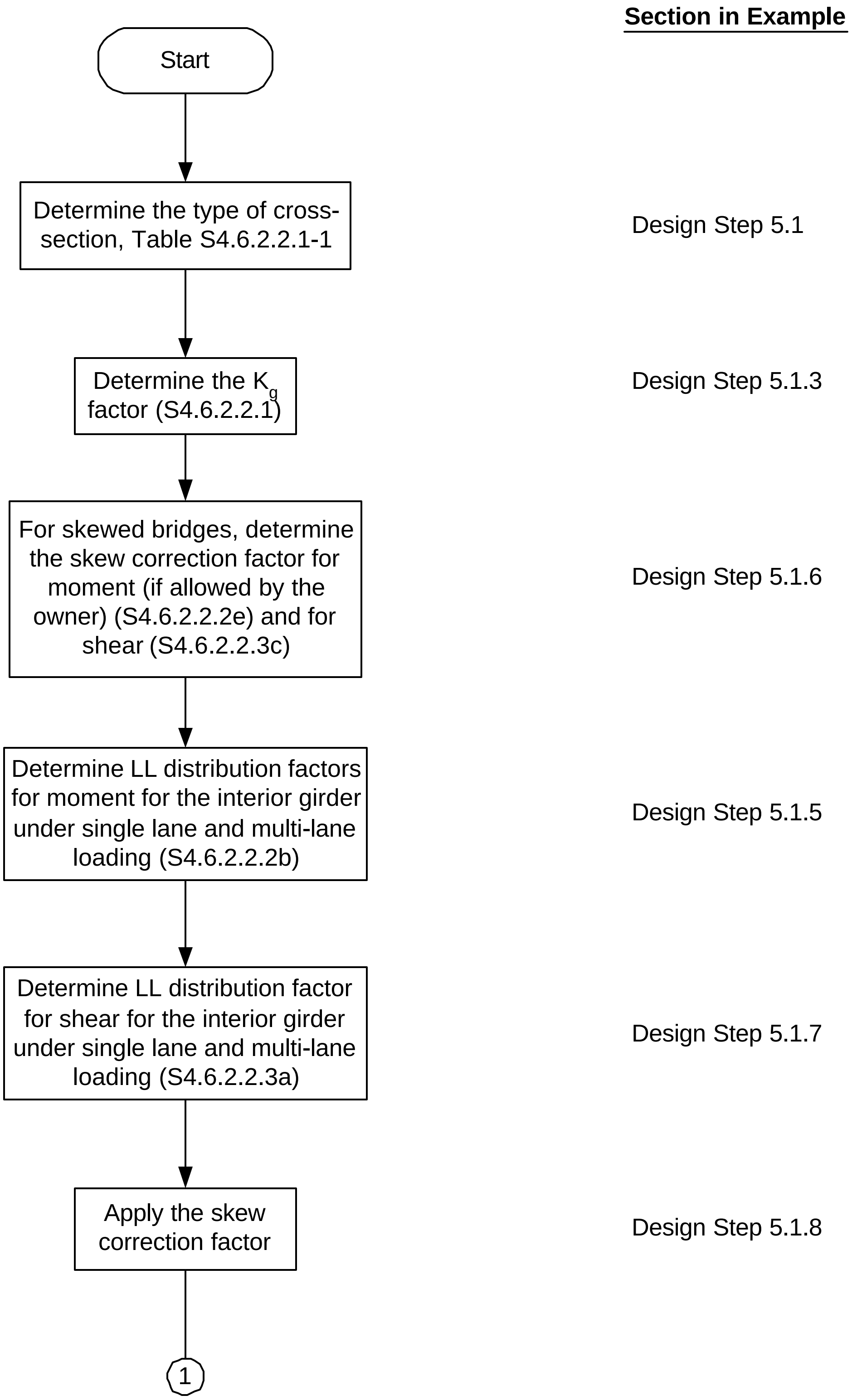
(Notice that only major steps are presented in this flowchart. More detailed flowcharts of the design steps follow this flowchart)



General Superstructure Design (cont.)

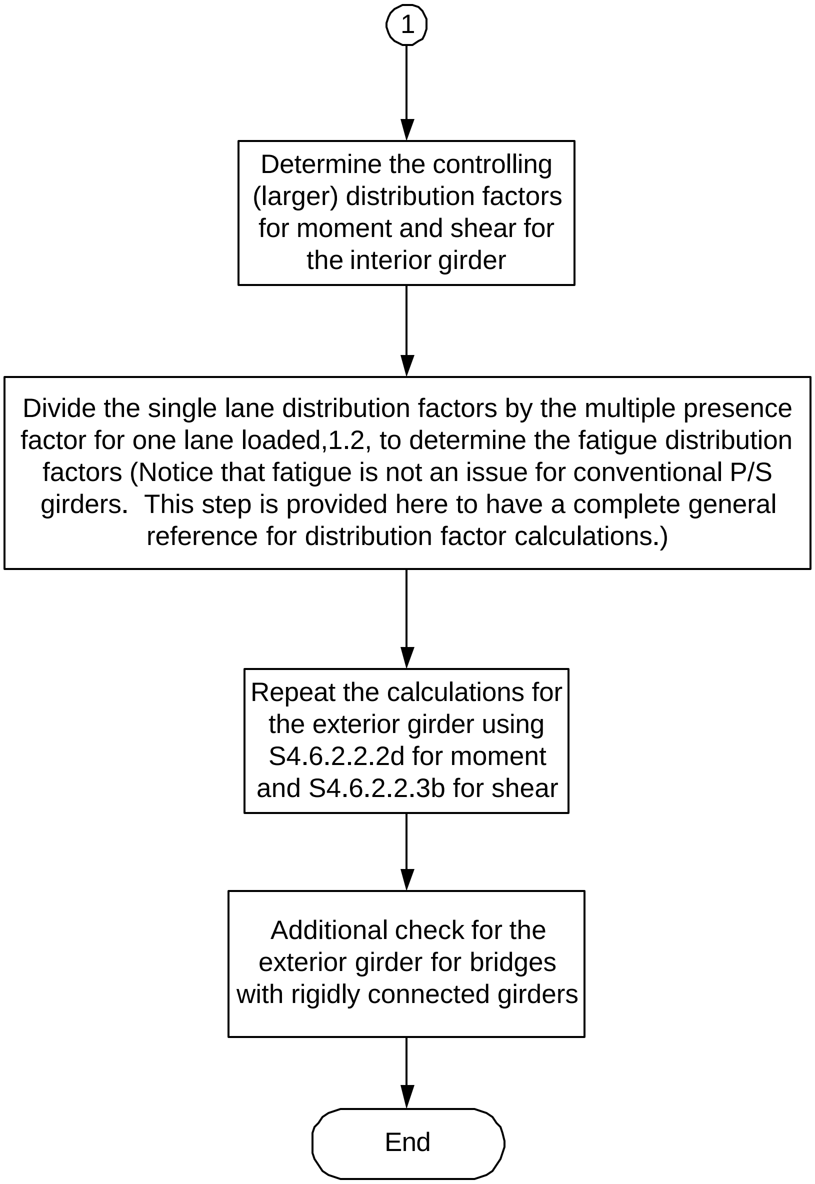


Live Load Distribution Factor Calculations



Live Load Distribution Factor Calculations (cont.)

Section in Example

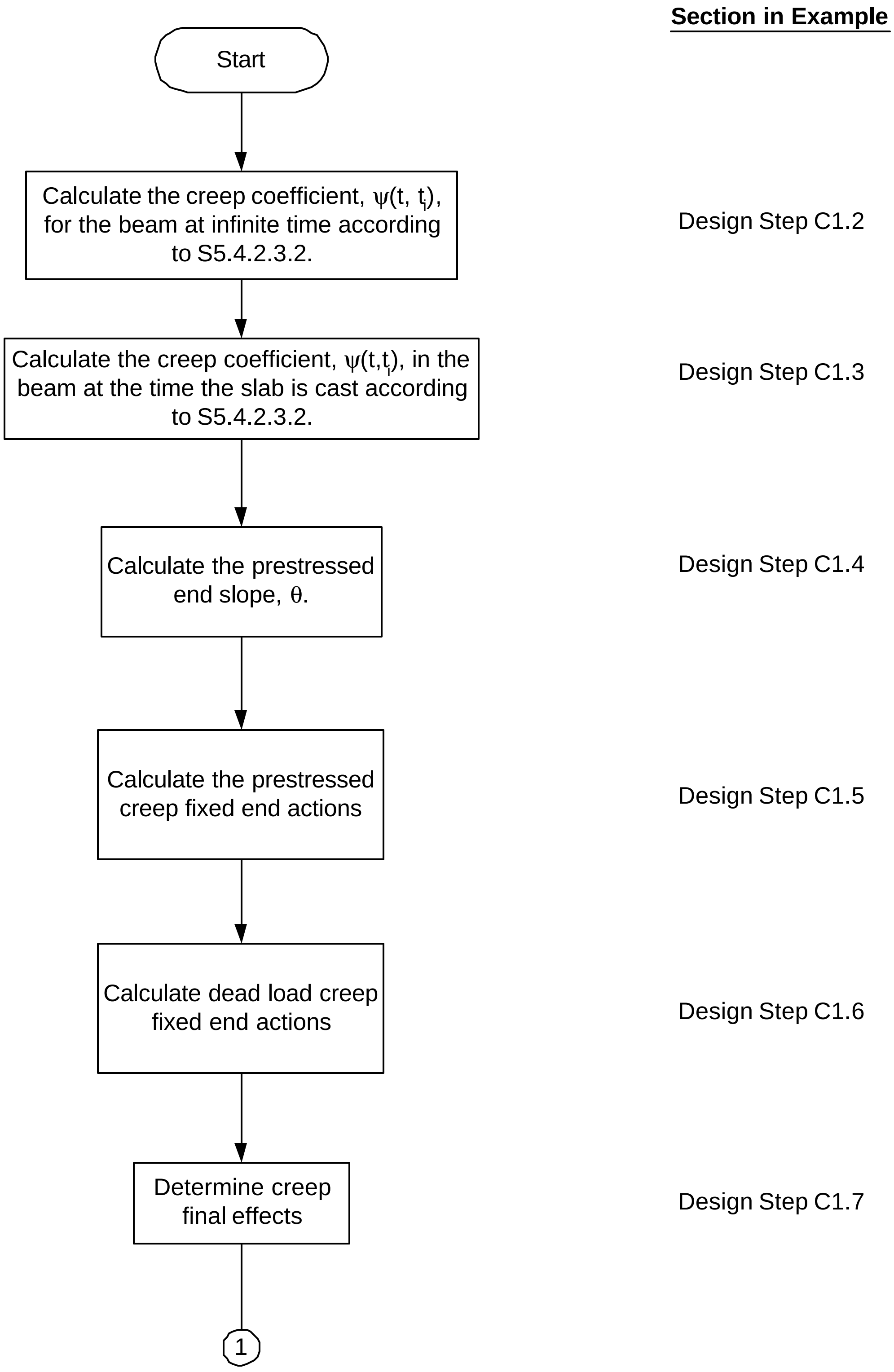


Design Step 5.1.9

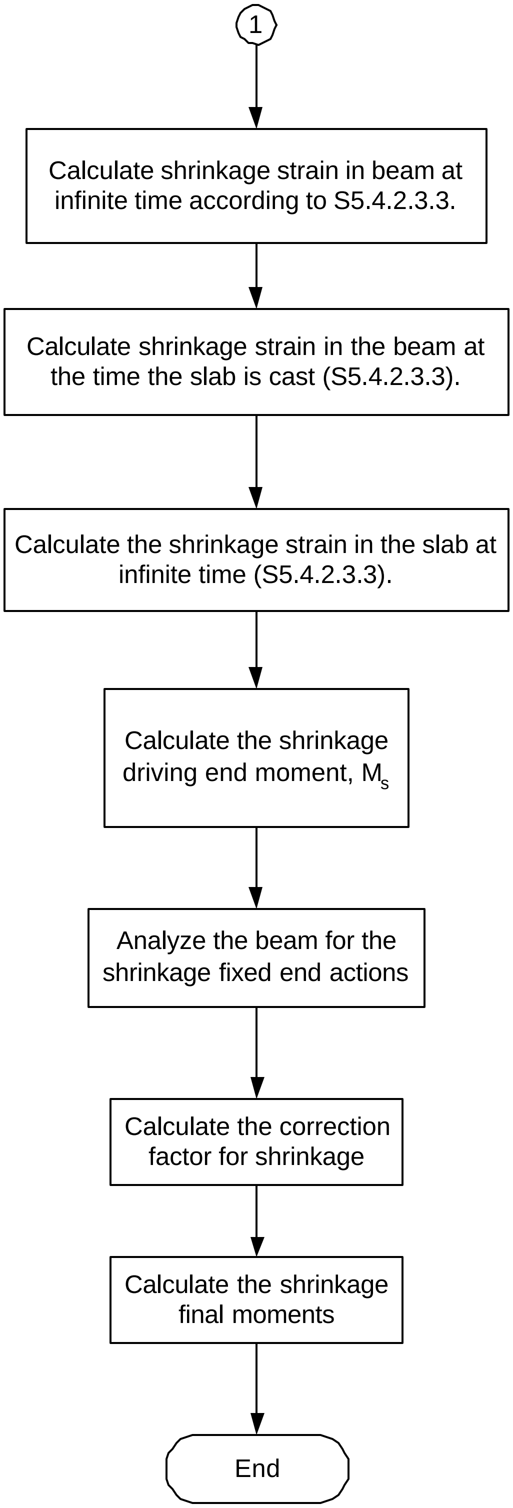
Design Step 5.1.10

Design Step 5.1.15

Creep and Shrinkage Calculations



Creep and Shrinkage Calculations (cont.)



Section in Example

Design Step C2.1

Design Step C2.2

Design Step C2.3

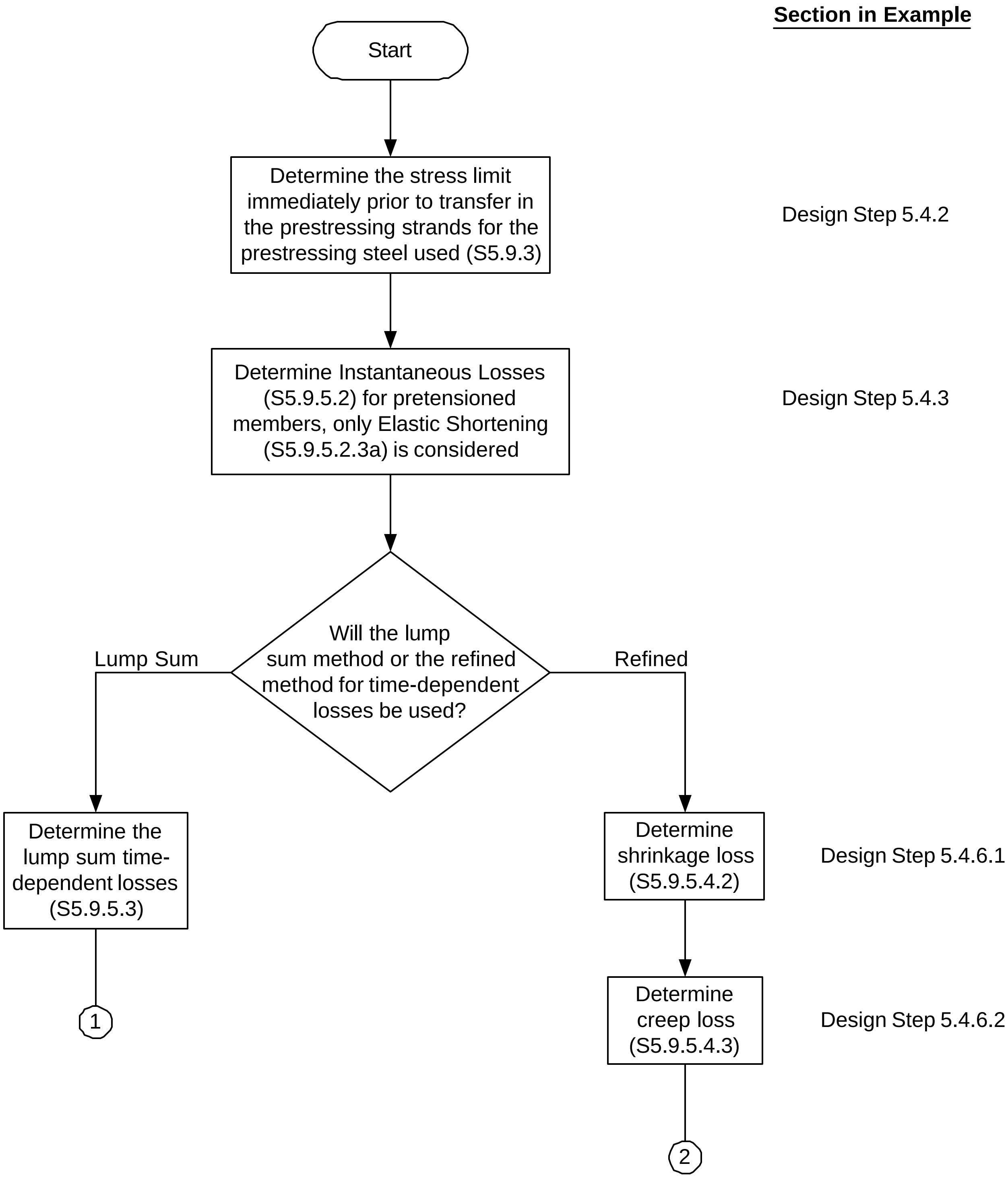
Design Step C2.5

Design Step C2.6

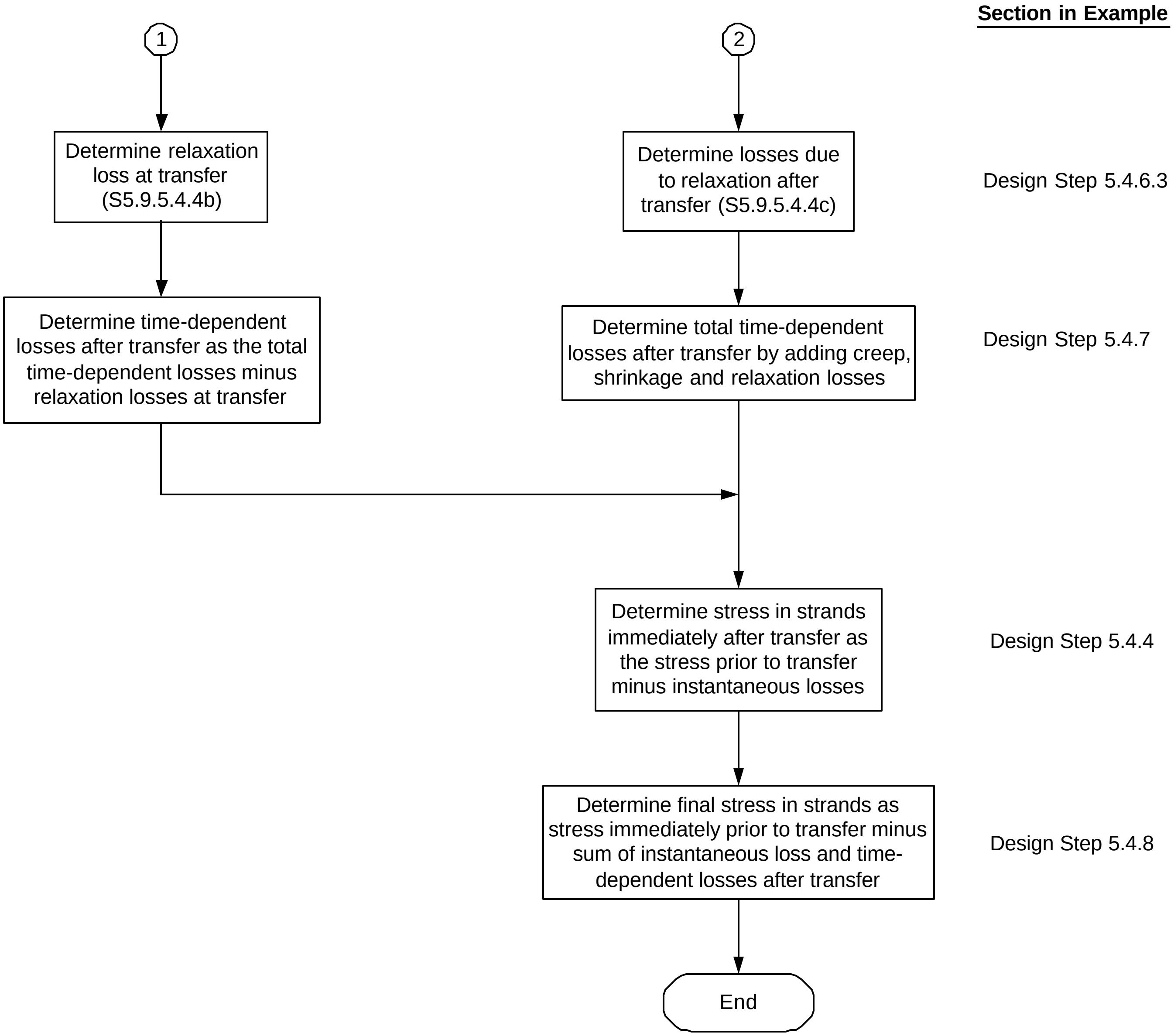
Design Step C2.7

Design Step C2.8

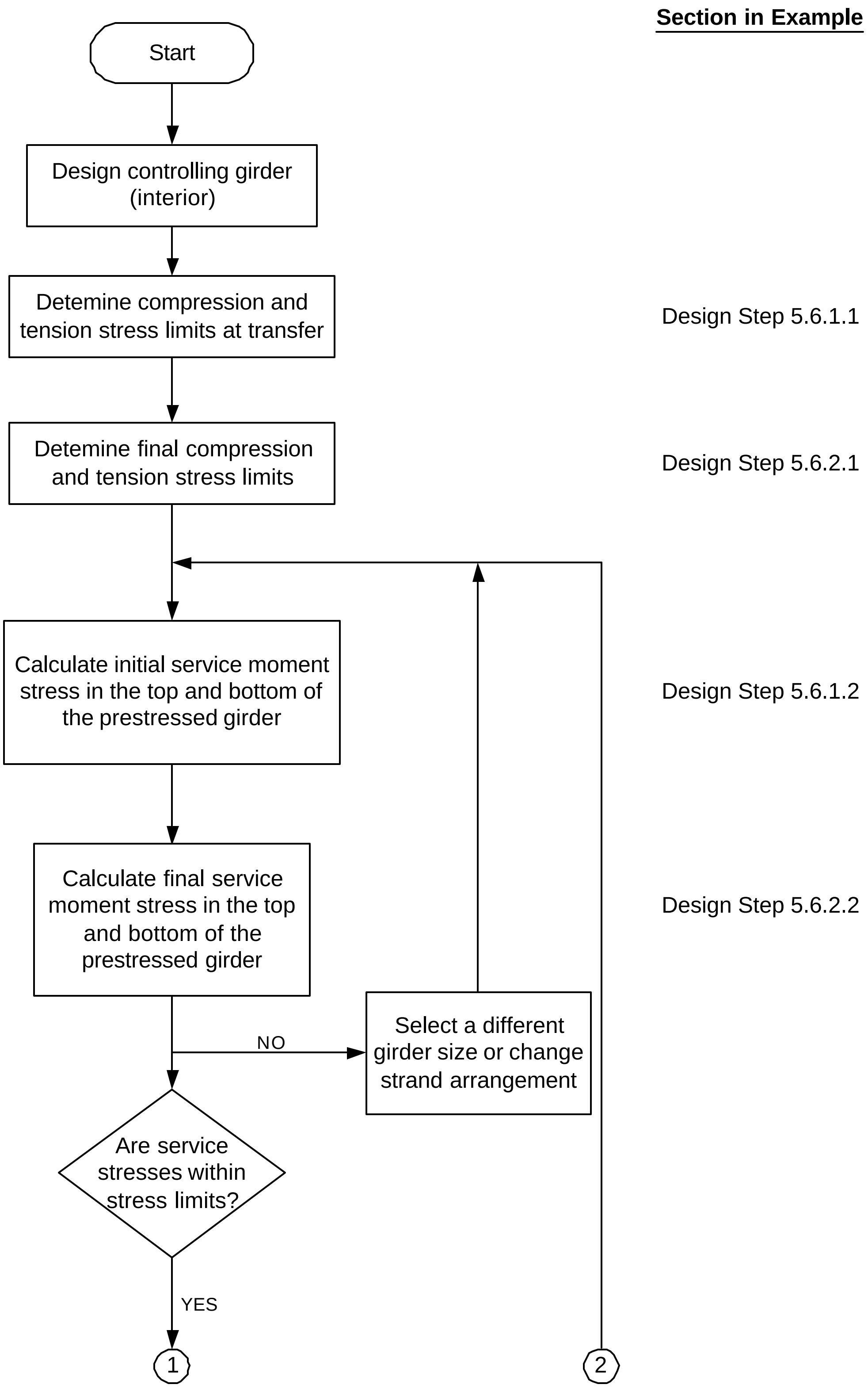
Prestressing Losses Calculations



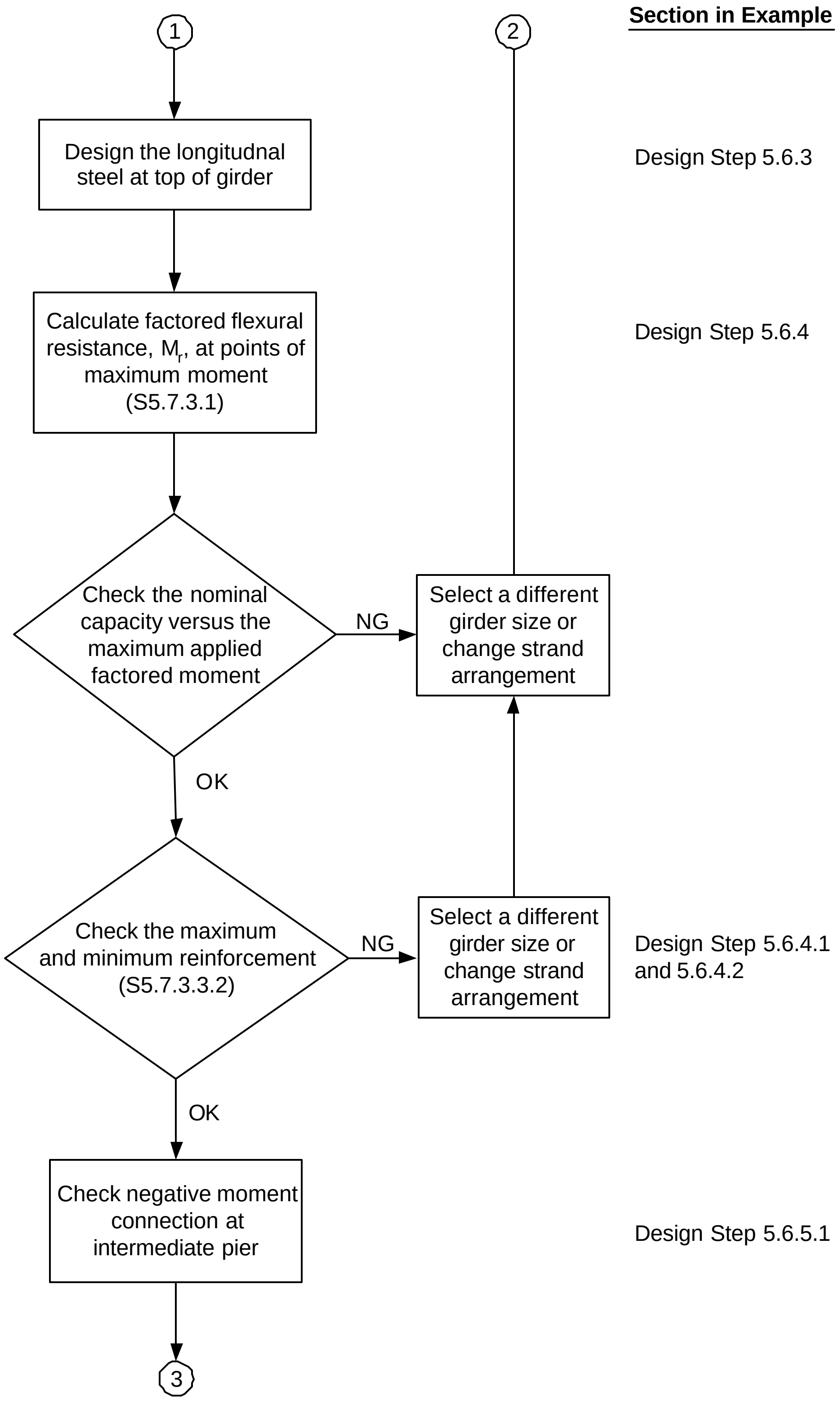
Prestressing Losses Calculations (cont.)



Flexural Design



Flexural Design (cont.)



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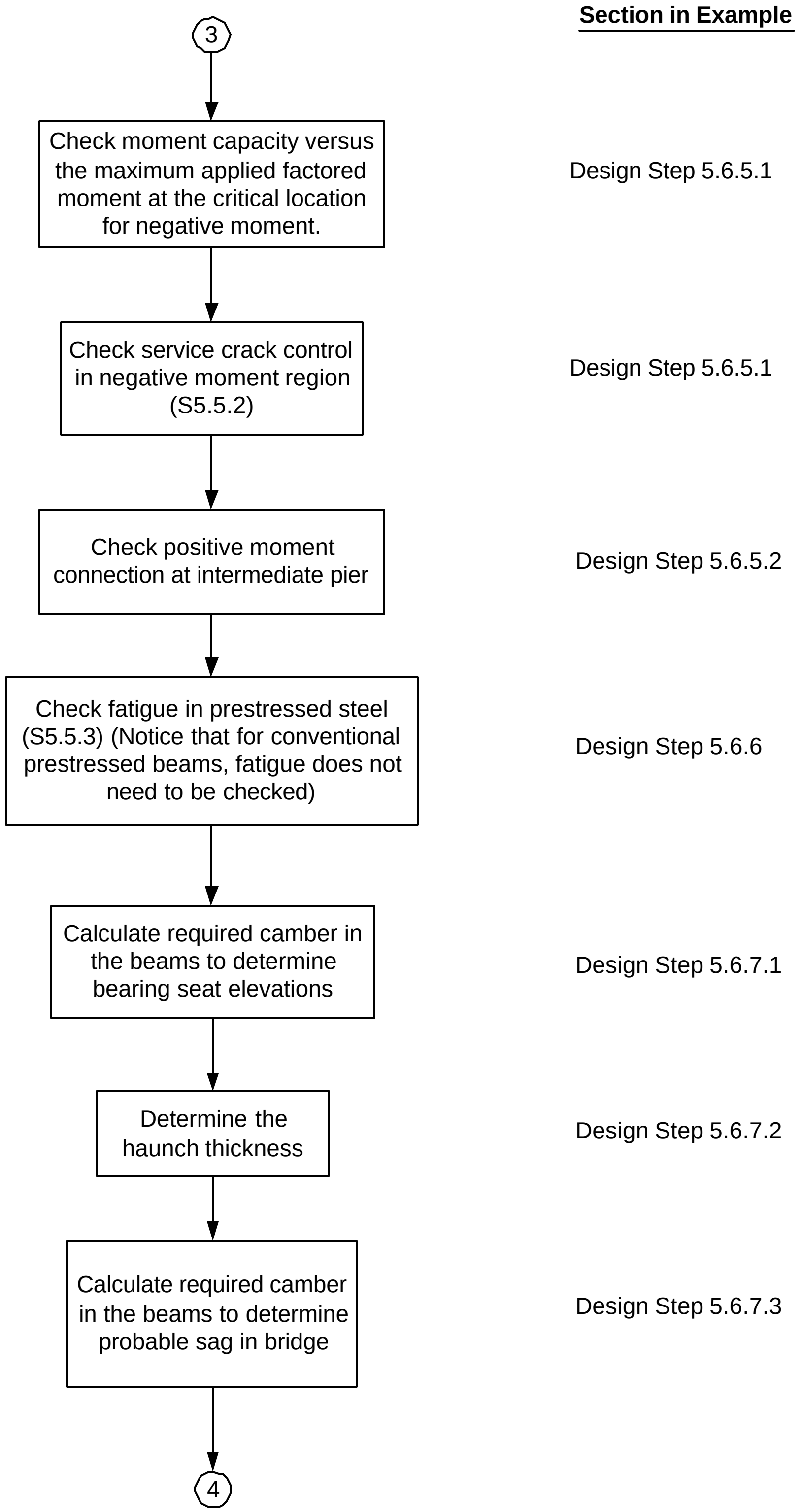

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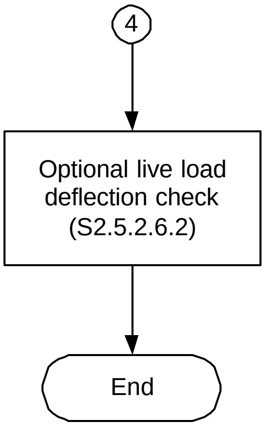
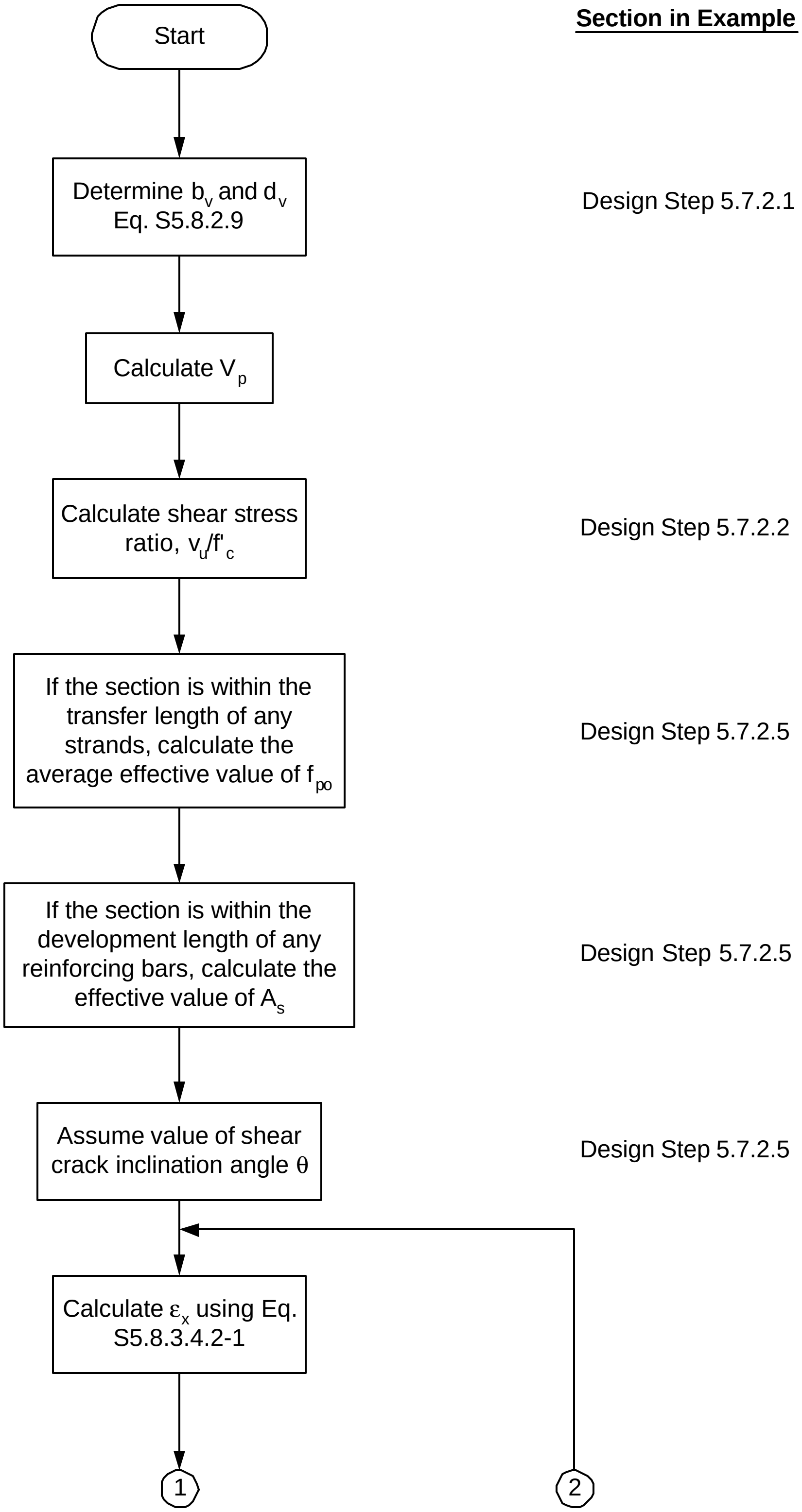


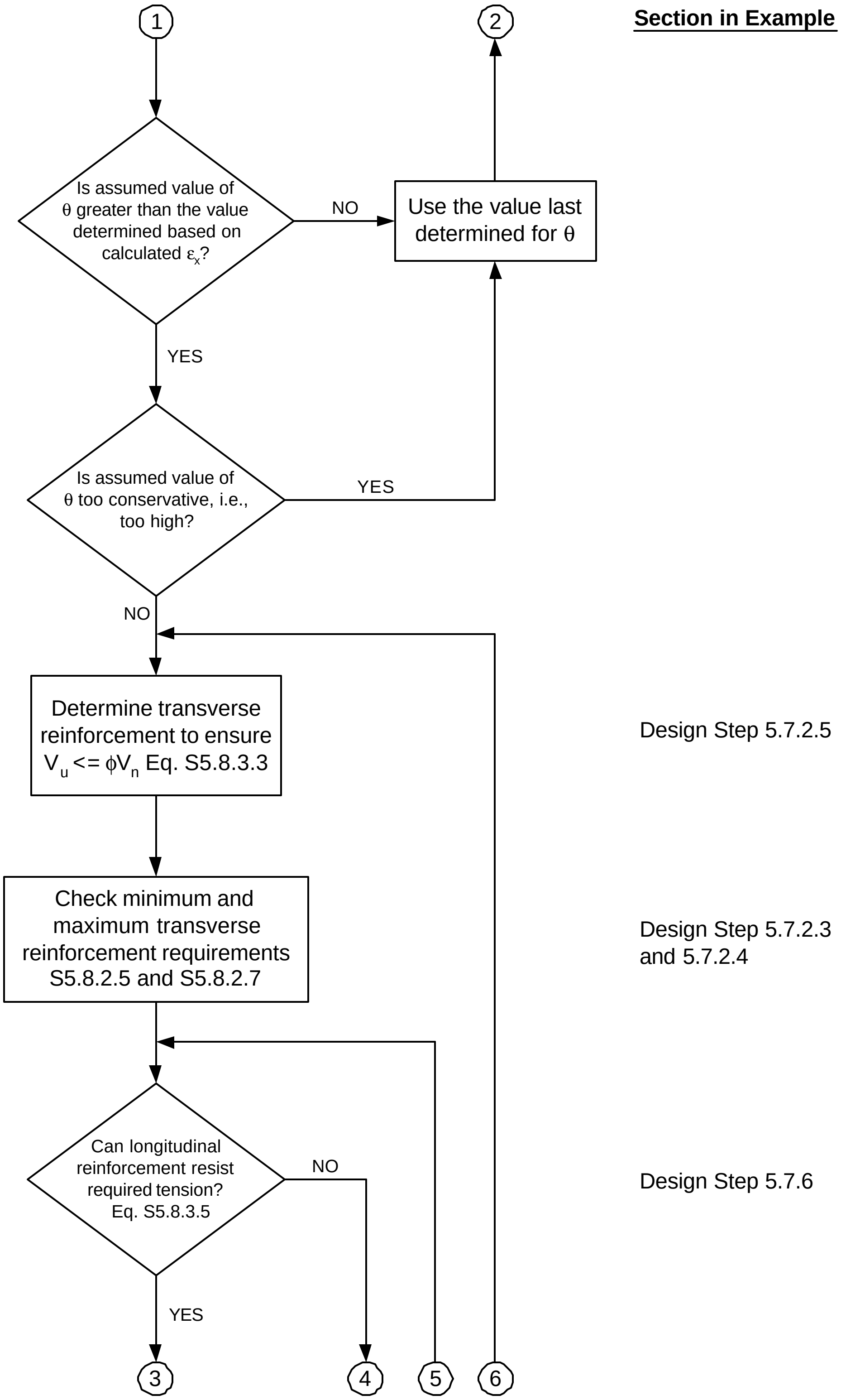
Section in Example

Design Step 5.6.8

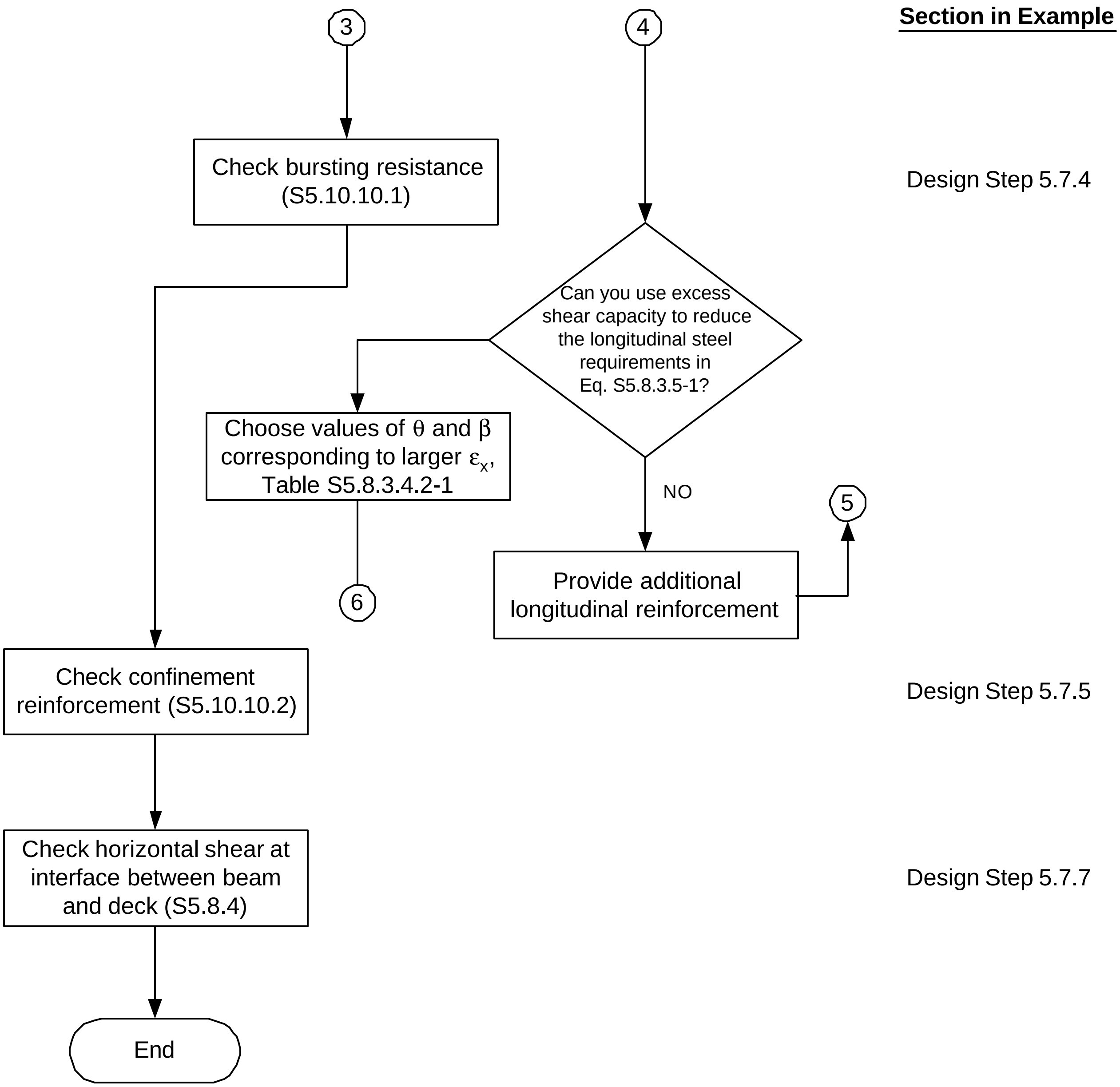
Shear Design – Alternative 1, Assumed Angle ?



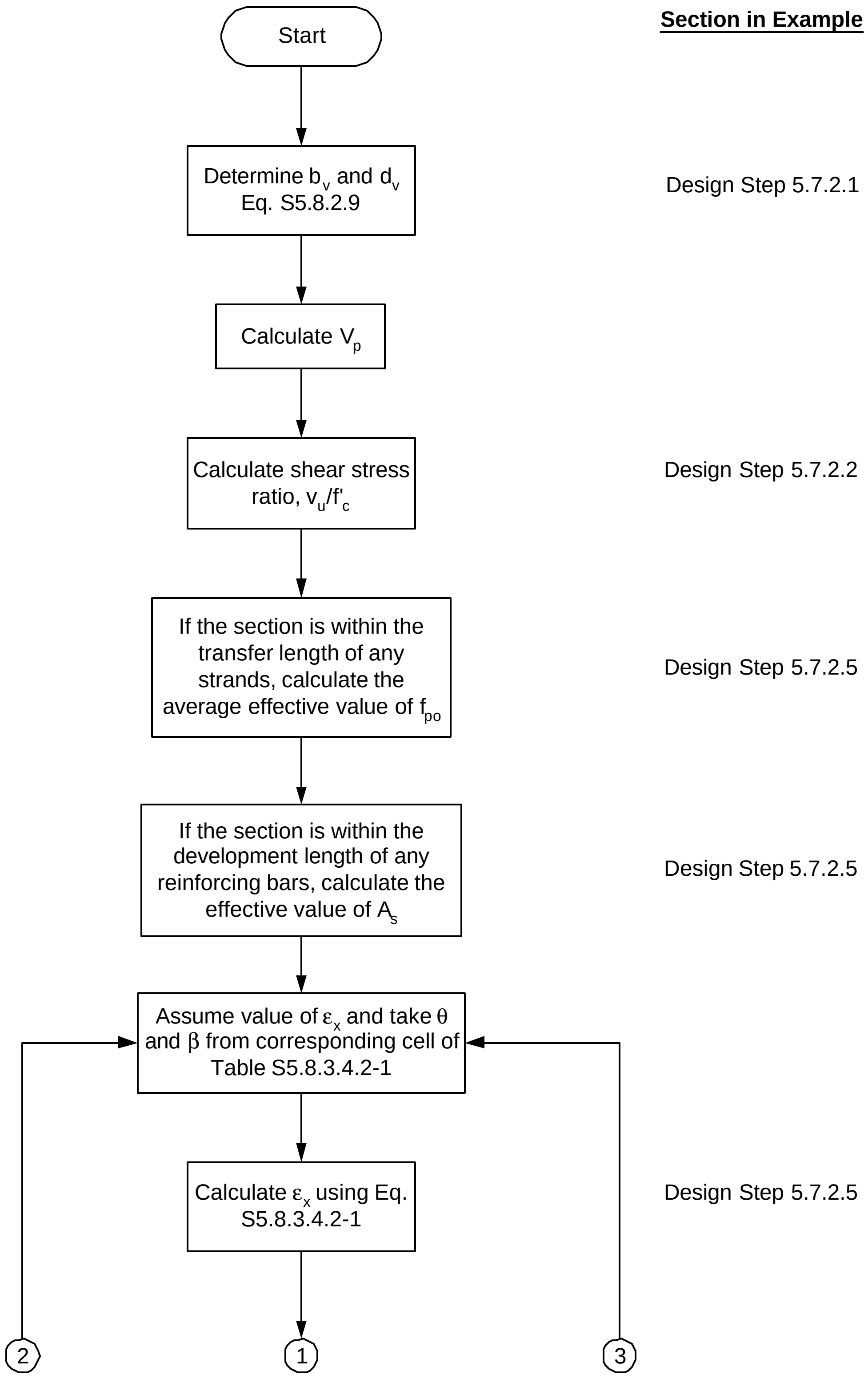
Shear Design – Alternative 1, Assumed Angle ? (cont.)



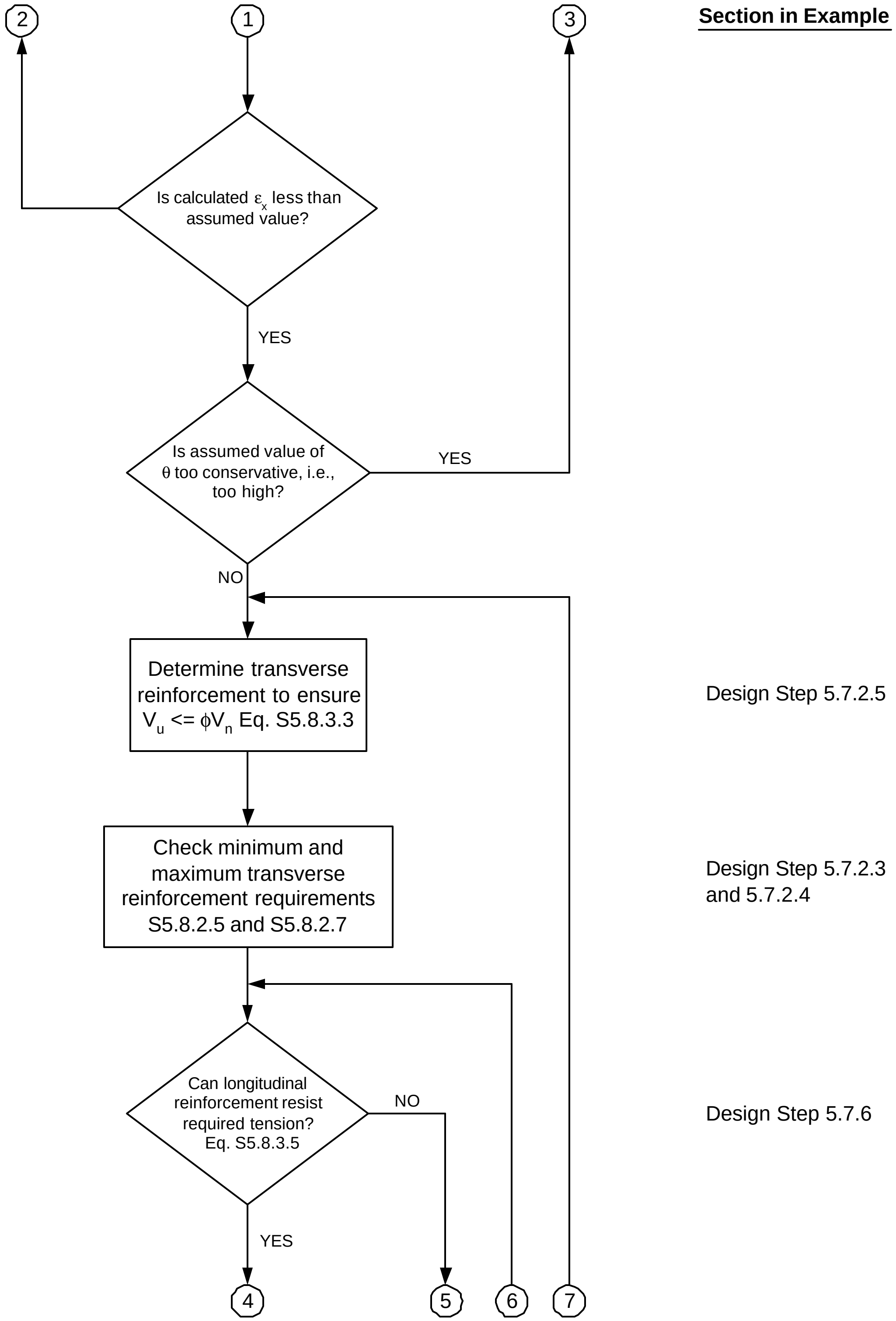
Shear Design – Alternative 1, Assumed Angle ? (cont.)



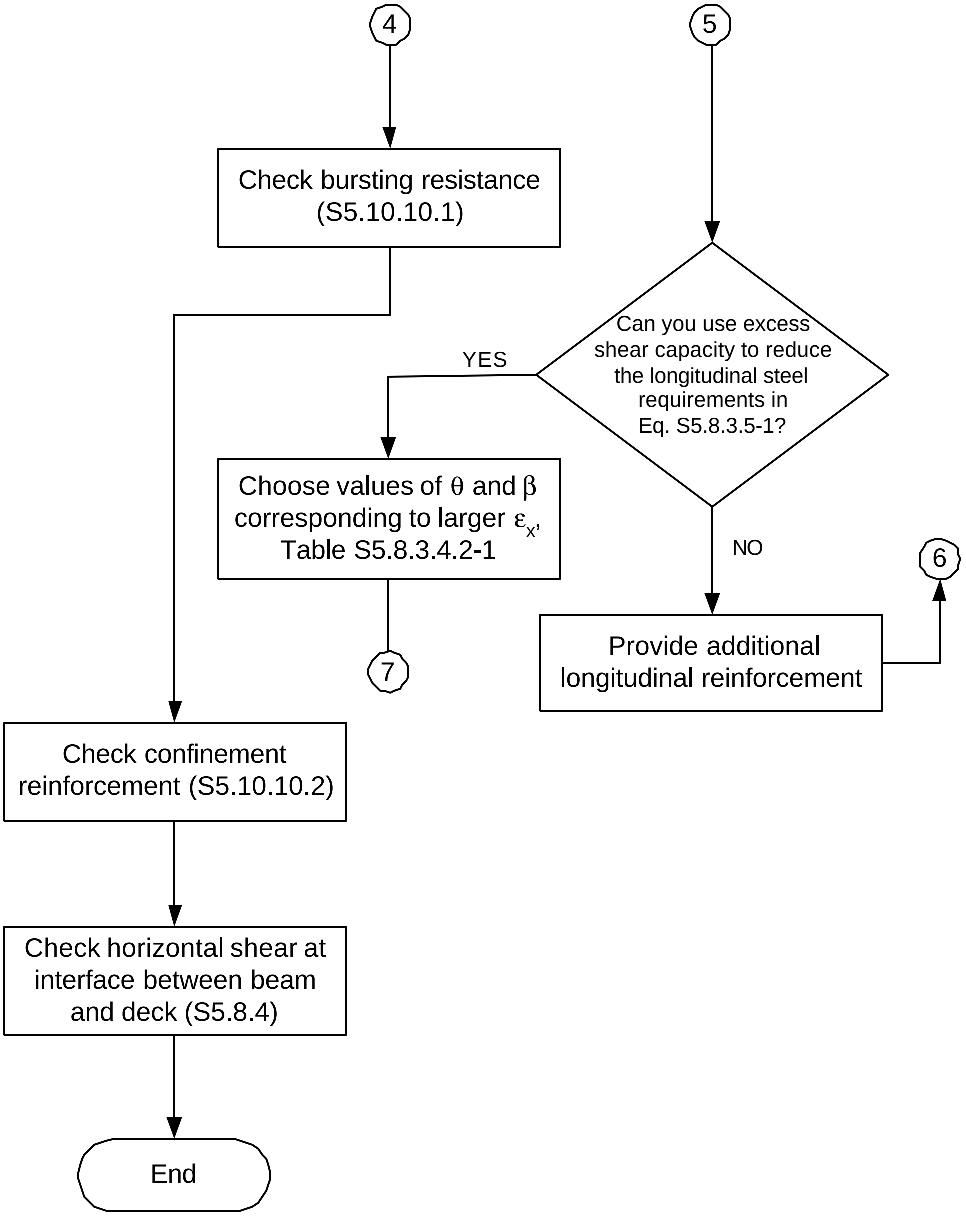
Shear Design – Alternative 2, Assumed Strain e_x



Shear Design – Alternative 2, Assumed Strain e_x (cont.)



Shear Design – Alternative 2, Assumed Strain e_x (cont.)



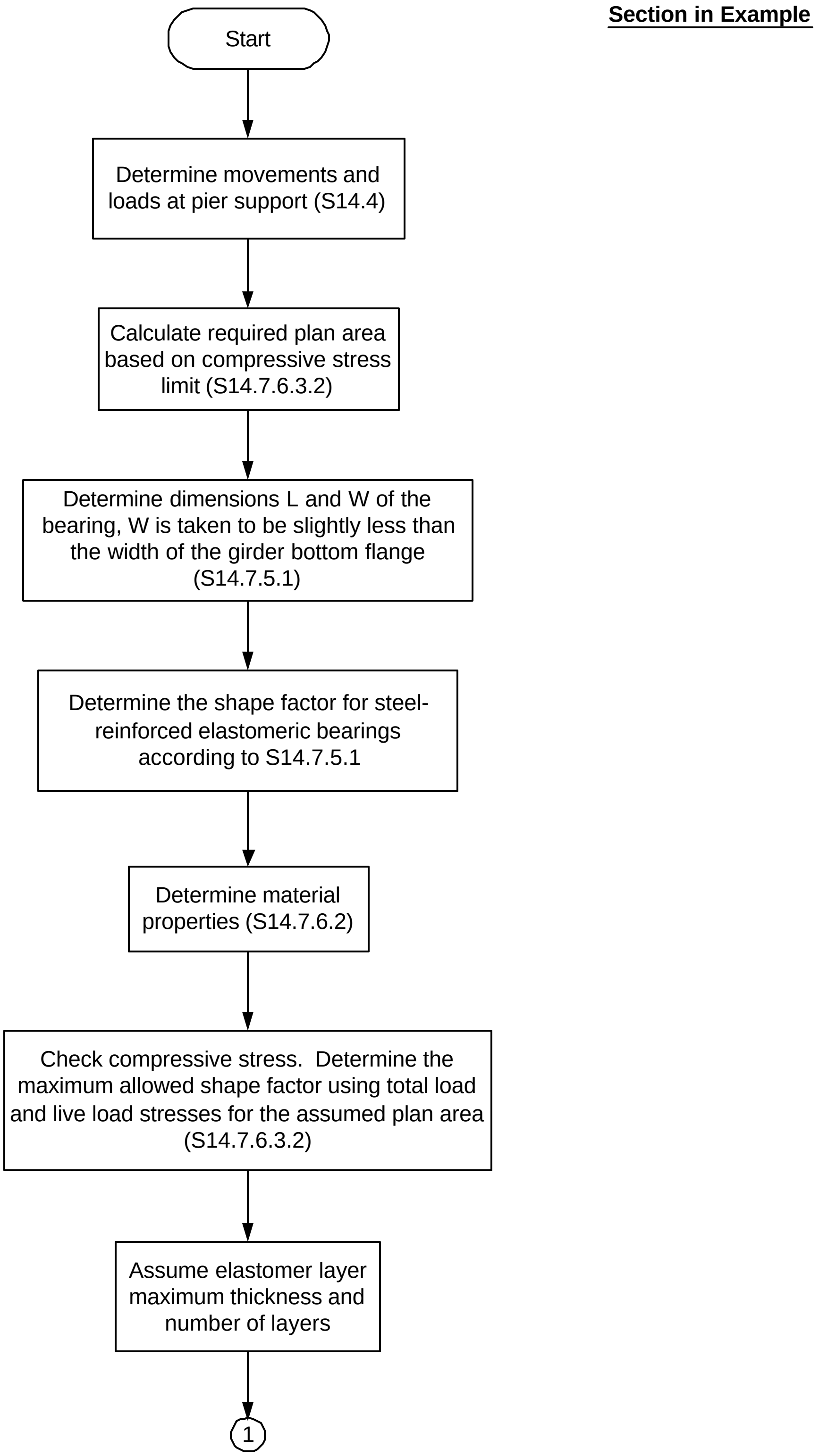
Section in Example

Design Step 5.7.4

Design Step 5.7.5

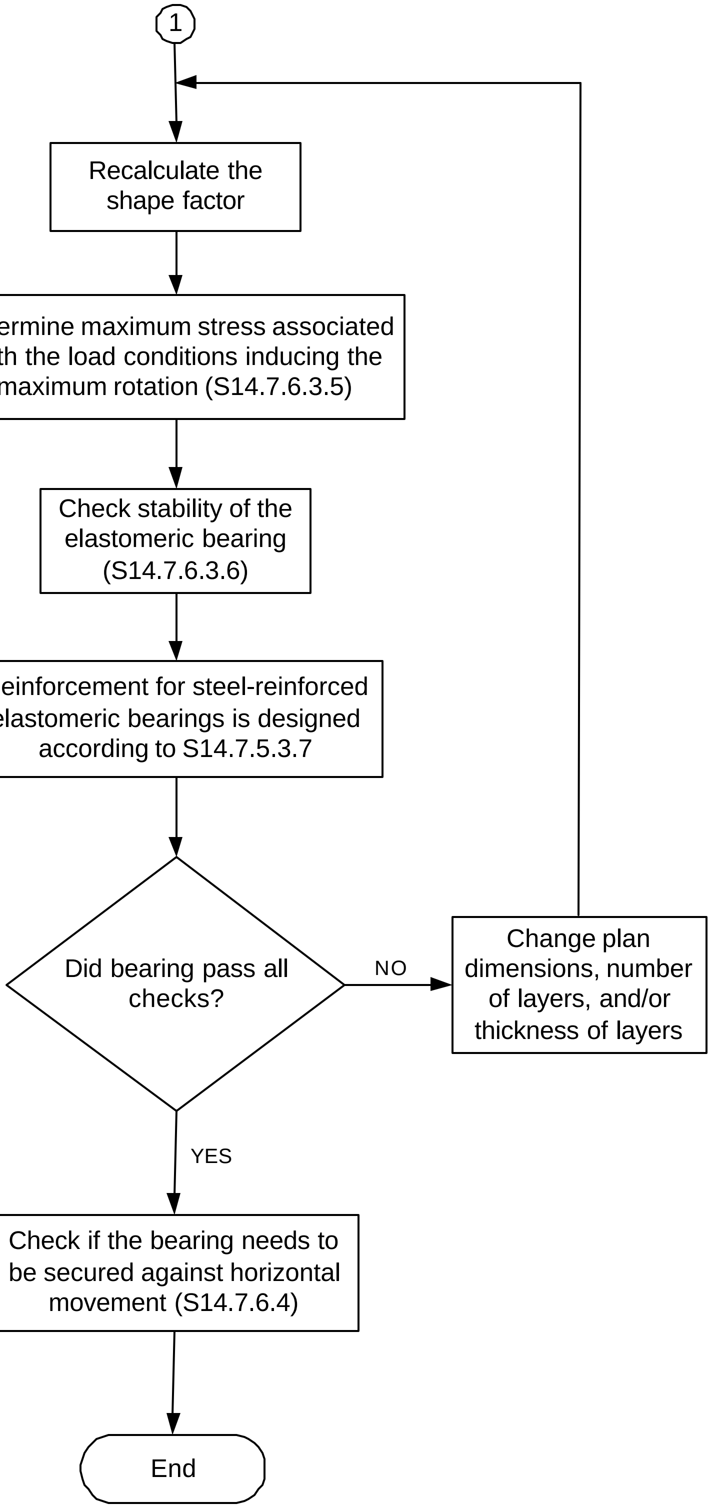
Design Step 5.7.7

Steel-Reinforced Elastomeric Bearing Design – Method A (Reference Only)

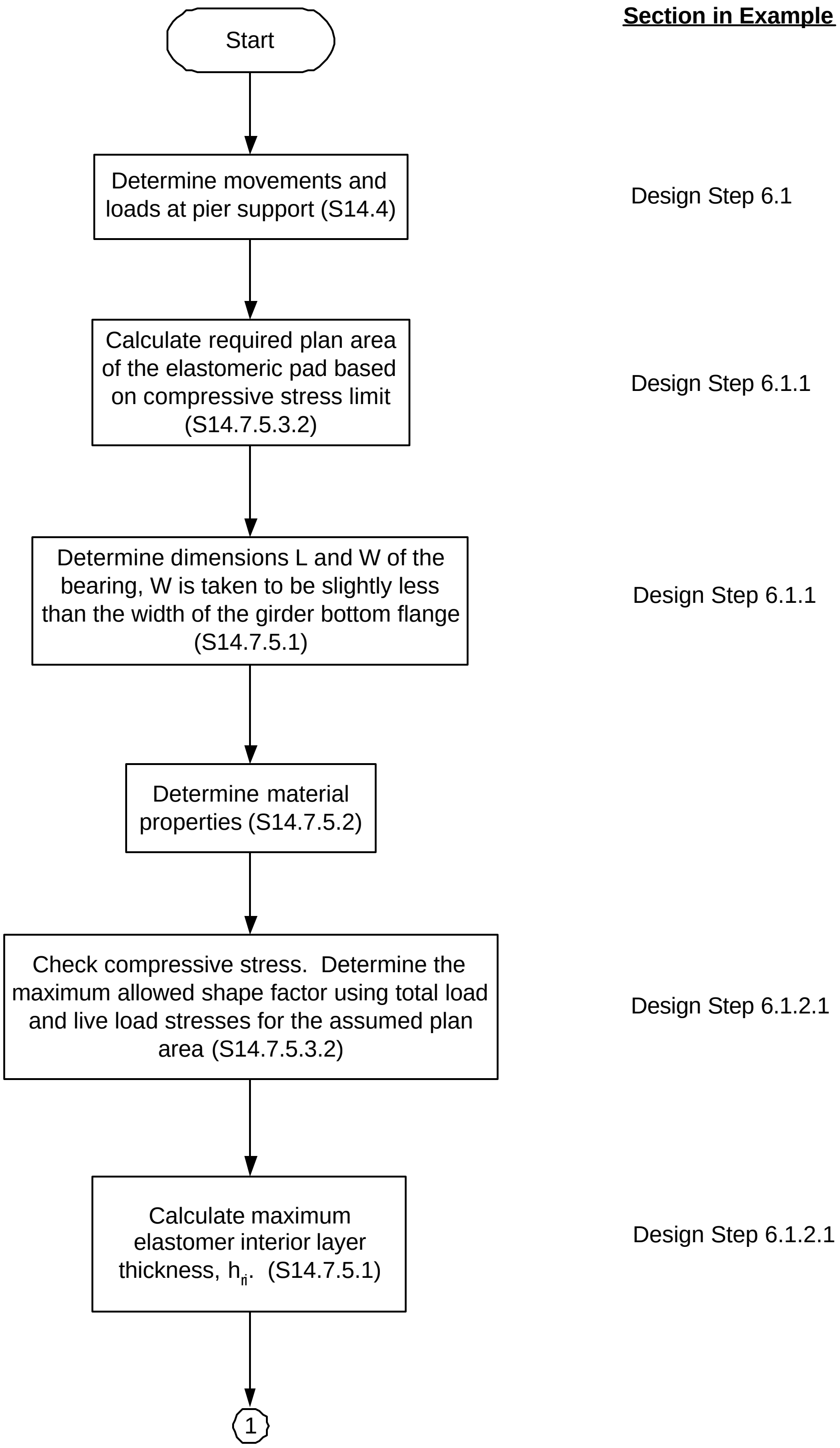


Steel-Reinforced Elastomeric Bearing Design – Method A (Reference Only) (cont.)

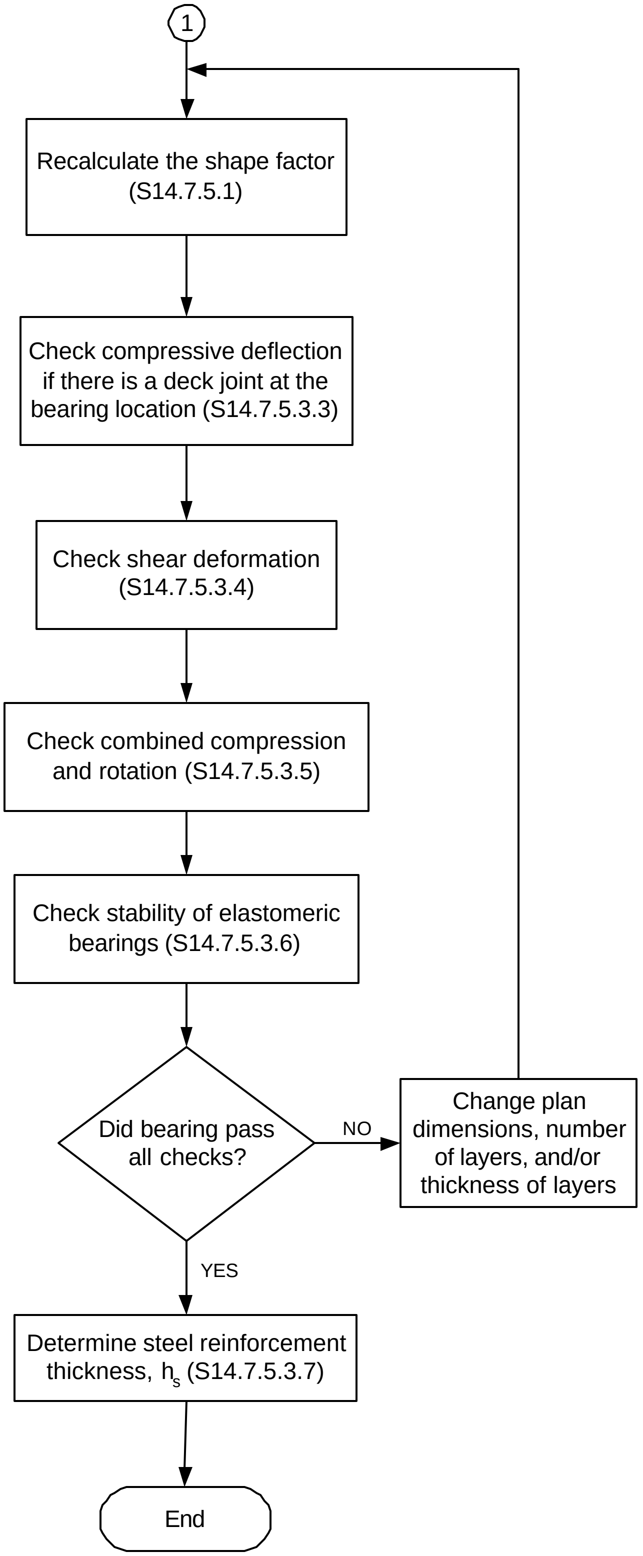
Section in Example



Steel-Reinforced Elastomeric Bearing Design – Method B



Steel-Reinforced Elastomeric Bearing Design – Method B (cont.)



Section in Example

Design Step 6.1.2.1

Design Step 6.1.2.2

Design Step 6.1.2.3

Design Step 6.1.2.4

Design Step 6.1.2.5

Design Step 6.1.2.6

SUBSTRUCTURE

Integral Abutment Design