Bridge Design - Concrete Bent Caps

Course Number: CE-02-409

PDH: 9

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Module 12: Concrete Bent Caps

Learning Objectives

By the end of this section, you will be able to:

- **Identify** the structural characteristics and applications of drop, integral, and inverted tee bent caps.
- **Calculate** factored moments, shear resistance, and reinforcement requirements using LRFD methodology and California Amendments.
- **Evaluate** specific detailing requirements for seismic resiliency, construction-stage stability (falsework settlement), and crack control.

Executive Summary: Concrete bent caps are critical intermediate supports that transfer superstructure loads to the foundation. This chapter provides a comprehensive framework for their design, covering load distribution, flexural and shear analysis via Modified Compression Field Theory, and the transition between conventional and deep beam behavior. Successful implementation requires rigorous attention to reinforcement detailing—particularly for integral construction and seismic demand—to ensure long-term structural integrity.

Introduction

A bent consisting of columns and a bent cap beam is an intermediate support between bridge spans that transfers and resists vertical loads and lateral loads such as earthquake and wind from the superstructure to the foundation. The bent cap beam supports the longitudinal girders and transfers the loads to the bent columns. Concrete bent cap beams may be cast-in-place or precast and may be either conventionally reinforced or prestressed.

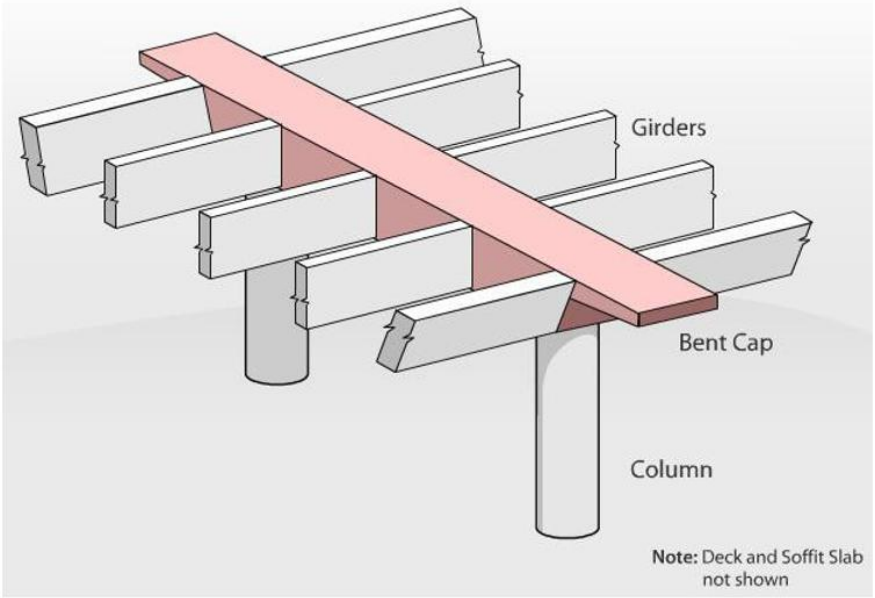

Figure 12.1-1. A Typical Integral Concrete Bent

Bents can be classified as a single-column, a two-column, or a multicolumn bent as shown in Figure 12.1-2.

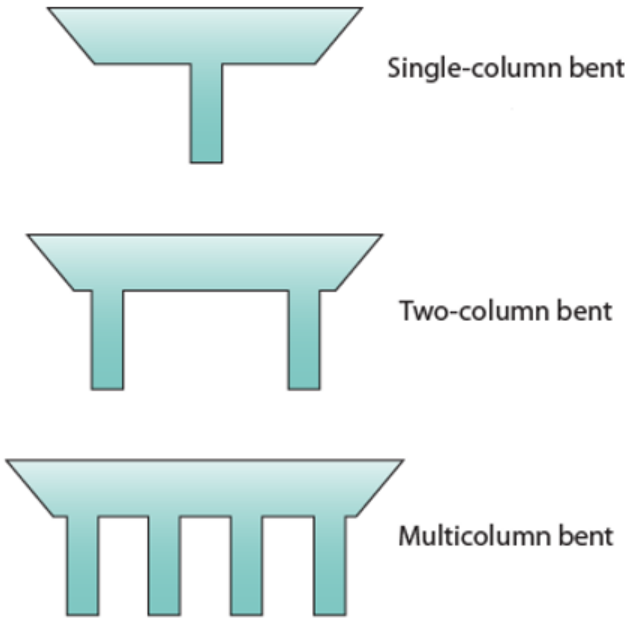

Figure 12.1-2. Typical Bents

Types of Bent Caps

The main types of bent caps are:

- **Drop bent cap**
- **Integral bent cap**
- **Inverted tee cap**

These may be configured in conventional bent types or unusual configurations like "C" bents and outrigger bents, and may possess asymmetric column configurations.

Drop Bent Cap

A drop bent cap supports the superstructure girders directly on its top. This type is generally used with precast concrete or steel girders.

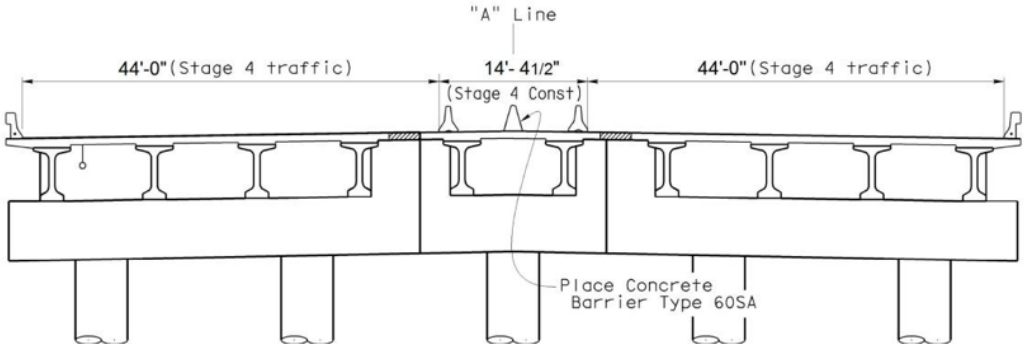

Figure 12.1-3. Overview of Drop Bent Cap

Drop bent caps may utilize different connection types to the superstructure diaphragm:

- **Fixed**
- **Pinned**
- **Isolated**

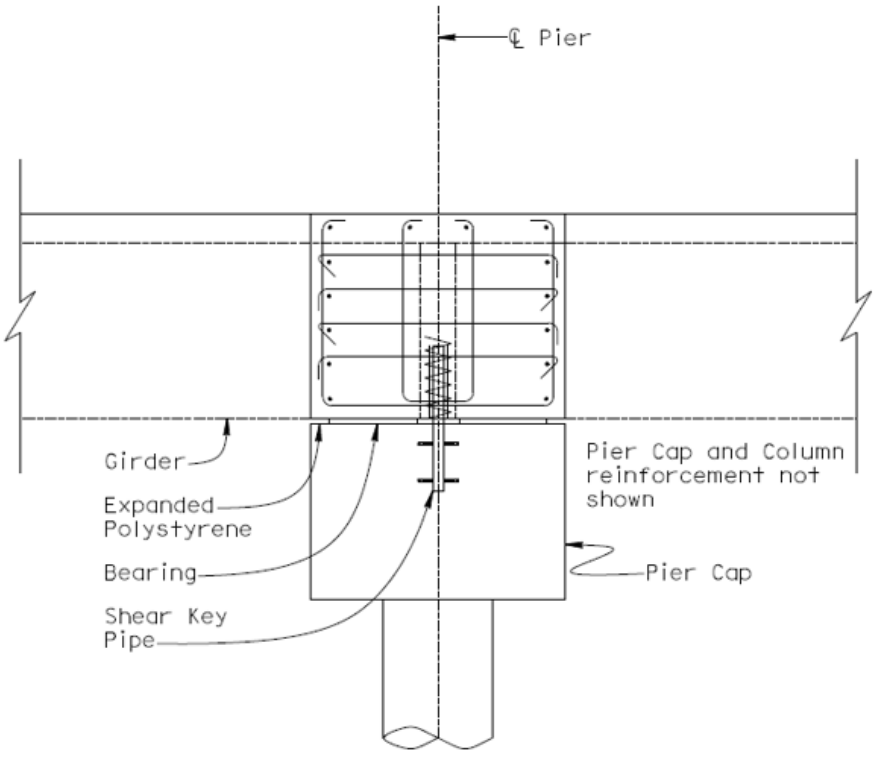

Figure 12.1-4. Drop Cap with Pinned Connection

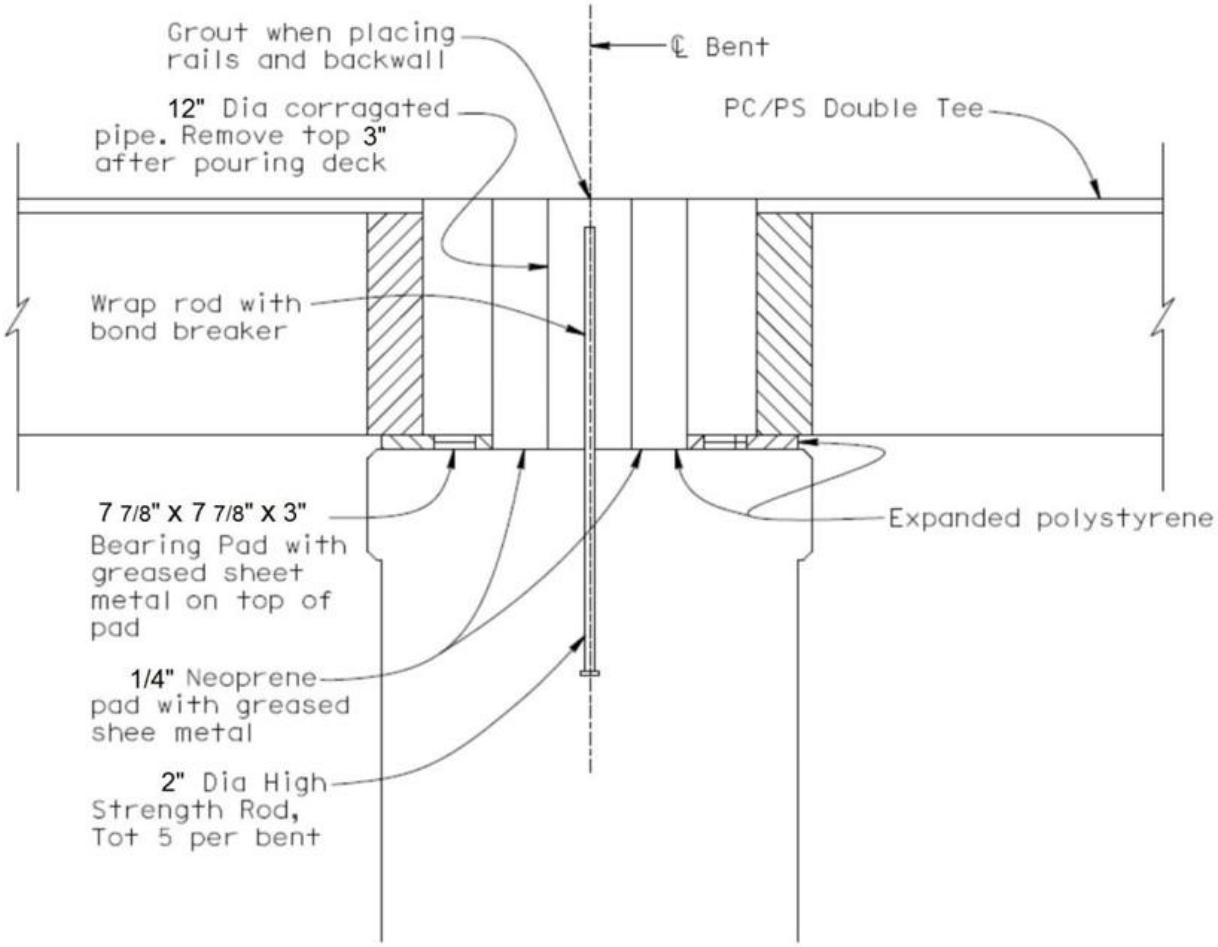

Figure 12.1-5. Drop Cap with Isolated Connection

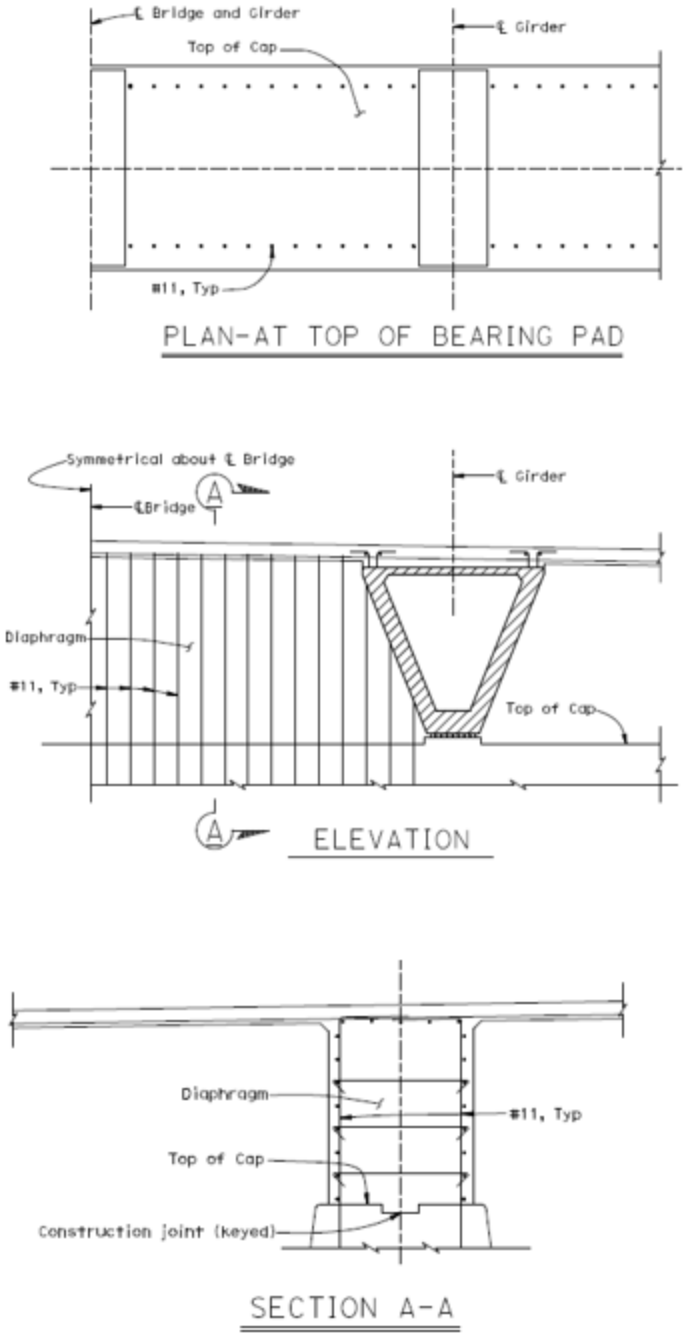

Figure 12.1-6. Drop Cap with Fixed Connection

Integral Bent Cap

Cast monolithically with the superstructure girders, an integral bent cap typically shares the same depth as the superstructure. This is standard in cast-in-place concrete box girder construction, where girder loads are transmitted as point loads along the cap's length.

Purchase this course to see the remainder of the technical materials.