BRIDGE DESIGN WITH MODERATE CURVATURE ON PLAN, USING ADAPT-ABI\(^1\)

The most expeditious way of designing a bridge is to follow the tradition of basing the work on separated longitudinal and transverse analyses, each conducted on its own, addressing the reinforcement along the bridge, and transverse to it respectively. Figure 1 shows the model for the longitudinal analysis of a box girder bridge. The transverse analysis of the same bridge is shown in Fig. 2. The two are performed separately.

![FIGURE 1 ANALYSIS MODEL FOR THE LONGITUDINAL DESIGN OF A BOX GIRDER BRIDGE](image1)

![FIGURE 2 ANALYSIS MODEL FOR THE TRANSVERSE DESIGN OF A SINGLE CELL BOX GIRDER BRIDGE](image2)

The separation of design into longitudinal and transverse analyses affords modeling of the bridge as a 2D structure for each case. The simplification in analysis translates into great efficiency in design without compromising the safety, in-service or the economy of the bridge. Moreover, the solutions obtained from a 2D analysis, such as the bending diagram of Fig. 1, are intuitive, thus reducing the likelihood of errors that are more common when interpreting the results of a 3D presentation. ADAPT-ABI in its basic form offers a full fledged 2D capability with state-of-the art allowance for time-dependent effects and construction phasing.

---

\(^1\) Copyright ADAPT Corporation 2010
Not all bridges are straight on plan. Where curvature on horizontal alignment is tight, or at bifurcations resorting to a (2.5D) analysis, or a full three dimensional analysis (3D) may be warranted. A 2.5D analysis applies to alignments of moderate curvature, where the effects of torsion about the alignment and the longitudinal bending can be well estimated for design purposes, without the necessity of a full 3D analysis. The 3D analysis is justified, where the effects of torsion and bending are intermingled to the extent that none can be reliably determined without the “simultaneous” consideration of the other.

Moderate curvature for a 2.5D analysis is defined as follows (refer to Fig. 3)

Moderate curvature: \( \frac{a}{L} \leq 0.1 \)

Where, “L” is the chord distance between two adjacent supports and “a” is the largest offset from the chord to the horizontal alignment. Radius of curvature “R” on its own does not set the threshold of whether a 2.5D or a 3D analysis is appropriate.

In a 2.5D analysis, in addition to the vertical alignment that is the basis of a 2D analysis, the horizontal alignment is also defined. The analysis proceeds in two steps. In the first step the geometry in the vertical plane is used and the bending moments in the longitudinal direction are determined. Using the moments of the first stage along with the horizontal alignment, in the second stage the value of ensuing torsion about the bridge alignment is determined. The analytical background to this procedure is given in Reference [Witecki, A. A]. In addition to the torsion resulting from horizontal alignment, the method can account for torsion due to loads being off-center with respect to the bridge centerline.

ADAPT-ABI versions 2009 and beyond have the capability of both 2D and 2.5D analysis, thus offering the efficient options of analyzing essentially all the commonly encountered bridges, but a few percentage.

Figure 4-a and 4-b illustrate the alignment and view of a curved bridge designed using ADAPT-ABI.
(a) ALIGNMENTS OF THE BRIDGE

(b) View of the completed bridge

FIGURE 4 CURVED BRIDGE DESIGNED USING ADAPT-ABI
(IH25 / 270 USA)

Figure 5 shows another curved bridge designed using ADAPT-ABI
FIGURE 5 PRECAST SEGMENTAL CURVED BRIDGE USING ADAPT-ABI