CHAPTER 6

LITERATURE REVIEW

6.1 Bridge Design

A bridge is a structure built to span a valley, road, railroad track, river, body of water, or any other physical obstacle, for the purpose of providing passage over the obstacle. Bridges can be classified by the way in which their members transmit load (axial force, flexure, or torsion), by the type of members used (plate girder, box girder, and so on), or by their method of transferring load to the foundations (for example, arch or tied arch, cantilever or beam). The bridge component can be divided in two parts such as superstructure and substructure. The superstructure consists of all components of a bridge above the supports for example, wearing surface, deck, primary members and secondary members. Figure 6.1 shows a typical superstructure. The substructure consists of all elements required to support the superstructure and overpass roadway for example, abutments, piers, bearings, pedestals, backwall, wingwall, footing, and piles.

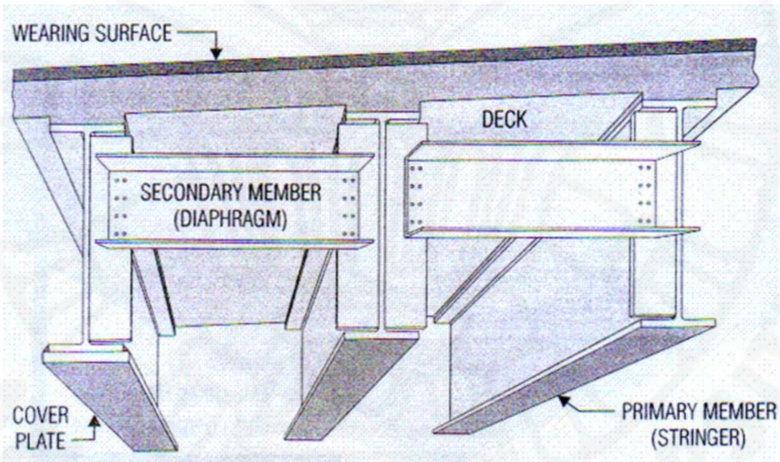

Figure 6.1 Principle components of a slab-on-stringer superstructure
Source: Demetrios et al. (2007)

The current design practice for the bridge structure in Thailand usually follows The American Association of State Highway and Transportation Officials (AASHTO) Standard Specifications for Highway Bridges (1996). In general, the design of bridge structure is based on a variety of following loads:

1. Permanent load
   Permanent loads are those loads which always remain and act on a bridge throughout its life.
   - Dead load
   - Superimposed dead load
   - Pressure

2. Temporary load
   Temporary loads are those loads which are placed on a bridge for only a shot period of time.
   - Vehicle live load
   - Earthquake loading
   - Wind loading
   - Channel forces
   - Longitudinal forces
   - Centrifugal forces
   - Impact (Dynamic load)
   - Construction loads

6.2 Steel-concrete Composite Bridge

One of the most popular types of the bridge in use today is the composite steel-concrete bridge. A typical composite concrete deck-slab on steel girder bridge consists of three major structural elements.

1. Concrete slab
2. Steel girders which interact compositely with the slab
3. Shear connectors

Figure 6.2 shows the typical composite concrete deck-slab on steel girder bridge.

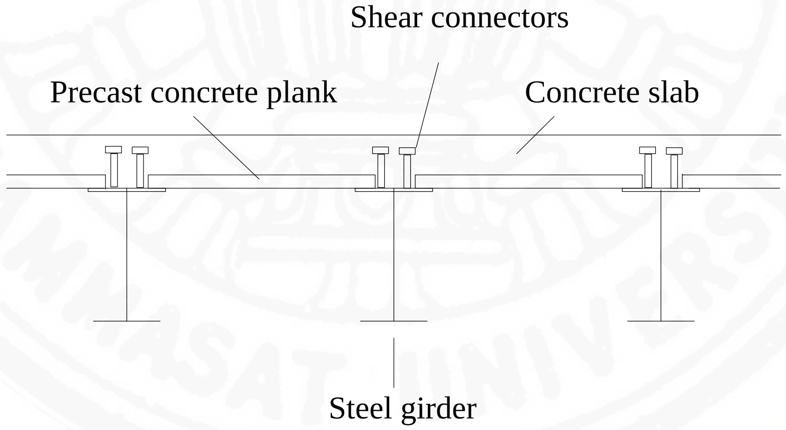

Figure 6.2 Composite steel-concrete bridge

The composite structure is put into account in order to build more efficient structure. A steel-concrete section are combined together to modify the behavior of the individual elements. With shear connectors welded to the top flange of a girder, a concrete slab can be carried the bending stress.

6.3 Typical Modeling of Bridges

The finite element method has been used to simulate successfully the behavior of a bridge in the past. Three dimensional nonlinear finite element models are generated to predict the actual behavior of masonry arch bridges (Fanning and Boothby, 2001). The dynamic characteristics of the cable-stayed bridge are studied by three-dimensional finite element model (Zhang and Chang, 2001). The stress analysis of a long-span cable stayed bridge from finite element analysis is compared very well with a full-scale static loading test (Lertsima et al., 2004). The dynamic interaction between a heavy tuck and highway is presented by the finite element analysis (Kwasniewski et al., 2006). Three-dimensional nonlinear finite element analysis of two-plate-girder bridge is conducted to obtain dry shrinkage and prestressing (Yamaguchi et al., 2005). The finite element method in combination with the boundary element is applied to analyze box-girder bridges (Galuta and Cheung, 1995). Finite element models are examined to predict the stress and deflection of steel-concrete composite girders (El-Lobody and Lam, 2003; Chung and Sotelino, 2006). Dynamic finite element modeling of composite girder-slab bridge is provided approximations the dynamic properties (Farrar and Duffey, 1998).