CHAPTER 6 CONCLUSIONS AND RECOMMENDATIONS

6.1 Conclusions

A study of the effect of bridge parameters on live load and dead load slab moments (M_{LL} and M_{DL}) of slab-on-girder bridge decks with a particular investigation of the use of bridge deck configuration and loading characteristic has been carried out extensively. The present parametric study with respect to bridge geometries and patterns of truck loading has been conducted by the refined three-dimensional finite element analysis so as to investigate the slab negative and positive moments due to live load M_{LL} (M^-_{LL} and M^+_{LL}). The appropriate finite element modeling approach of such bridge has been studied by means of assigning different element types to the bridge components. The so-called Eccentric Shell-Beam Model (**ESBM**) using thick shell elements for concrete slab and beam elements for steel I-girder has been selected owing to its reliabilities and used for the present bridge parametric study.

Among the parameters having an effect on M_{LL} and M_{DL}, the present analysis has revealed the following findings:

1. The girder spacing S has a significant influence on M_{LL}. As S becomes larger, M_{LL} increases in general. Note that for M^-_{LL} the effect of S is largest at support and smallest at mid span and vice versa for M^+_{LL}.
2. The pattern of lane loading N_L produces an influence on M^-_{LL} to a certain extent while it can be ignored for M^+_{LL}. Great influence of N_L can be clearly observed at support region.
3. The location along the bridge span y where M_{LL} is of interest has a scientific influence on M_{LL} to a great extent. In particular, as the considered location approaches mid span, M^+_{LL} increases in general (maximum variation = 75%). On the other hand, when the considered location is apart from support, M^-_{LL} usually decreases (maximum variation = 107%).
4. The slab hogging phenomenon has a propensity to alleviate M_{LL} at the location where the structural flexibility of bridge decks is large, *i.e.* in the vicinity of mid span.
5. Compared with other existing approaches in the evaluation of M_{LL}, nominal results of M_{LL} based on the present study have implied that the bridge slab reinforcement may be moderated when the bridges with small S have been selected.

6. The difference in flexural rigidity of the girders in longitudinal direction can cause the variation of M^{+}_{LL} in general whereas it contributes a small effect on M^{-}_{LL}. To be specific, for medium span bridge (15-27 m) the effect of longitudinal flexibility on M^{+}_{LL} is larger than that of short span bridge (***L*** $\leq$ 15 m) and appears to be insignificant in case of M^{-}_{LL}.
7. The analysis of $\boldsymbol{M_{DL}}$ has revealed that dead loads of bridge deck are typically considered as a small fraction of the deck loads. Therefore the traditional method to determine $\boldsymbol{M_{DL}}$ provided by AASHTO Specifications should be sufficient for this bridge deck design.
8. In support of an applicable aspect, empirical formulas based on the present study have been proposed to alternatively compute $\boldsymbol{M_{LL}}$. It has been confirmed that the proposed formulas yield $\boldsymbol{M_{LL}}$ in good conservative agreement with the present finite element results.

Application of the methods of present analysis described earlier shows a promising ability in providing analytical tools and an alternate solution to supporting a bridge slab design. The potential advantage of the present study is that the present study provisions may be used as an alternative method other than the former traditional design procedures as it can stand for a refined-analysis-based method, which should be less expensive.

6.2 Recommendations for Further Research

To validate the analytical procedures described in this dissertation and to evaluate the effect of other design parameters using a similar procedure, future research efforts should include the following:

- Conduct additional field tests on bridges with different girder spacing and deck design parameters to confirm the analytical results predicted by the present study and by future studies.
- Evaluate the effect of reinforcement configuration on deck behavior, specifically the importance of top steel in deck response.
- Evaluate the effect of skew angle on deck behavior, with special attention given to the reaction forces developed in the plane of the deck and their interaction with abutments and piers.
- In order to take advantage of the benefits of advanced analysis techniques, without unnecessary complication of the design process, non-linear analysis and consideration of slab membrane action, which provides the potential for significant refinement of deck slab design should be studied more extensively.