STUDY ON THE VERTICAL BUCKLING COLLAPSE OF I –SHAPED STEEL GIRDERS

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1. BUCKGROUND AND PURPOSE

In this paper, collapse behavior of flange vertical buckling of an I-shaped girder having practical shapes and dimensions is studies.

Generally, collapse behavior of an I-shaped steel girder is classified into 3 patterns such as (1) lateral torsional buckling, (2) flange torsional buckling and (3) flange vertical buckling. Within these patterns, flange vertical buckling occurs only on the case that the girder has the very thin and weak web plate [1]. Basler et al. proposed a formula to verify occurrence of flange vertical buckling [2]. However, Shimizu et al. pointed out that the actual collapse behavior of the vertical buckling may be differ with the Basler's assumption, and therefore their formula is not suitable for the practical use [3-4]. This fact indicates that the further studies are required on behavior of vertical buckling.

In this paper, following to the authors' previous studies [5], results of the numerical analysis on flange vertical buckling are described. In the author's previous studies, a 2-points loading on a small sized girder, which are of the experimental test by one of the authors [3] presented in the Solmech 2014 conference, is used. However, in the current paper, considering the practical design procedure of actual bridges, the distributed loading on a girder having practical section dimensions is adopted. With this loading and the numerical model, vertical buckling behavior in the practically erected bridge girders can be revealed.

2. NUMERICAL MODEL AND RESULT

The numerical model of the current study has the span length of 29 800 mm, web height of 2500mm. In this paper, hybrid steel girder, which consists of the high strength steel for its flange plate and the normal (or low yield) steel for the web plate, is dealt with as a numerical model. For the flange plate, the grade SM570 steel with the yield stress of s_y=596 MPa is assumed while the central part of the web plate is of LY235 low yield steel with s_y=265 MPa and the remained part of the web of SM400 steel with s_y=360 MPa. Fig.1 shows the outline of the numerical model. In the analysis, distributed loading is considered.

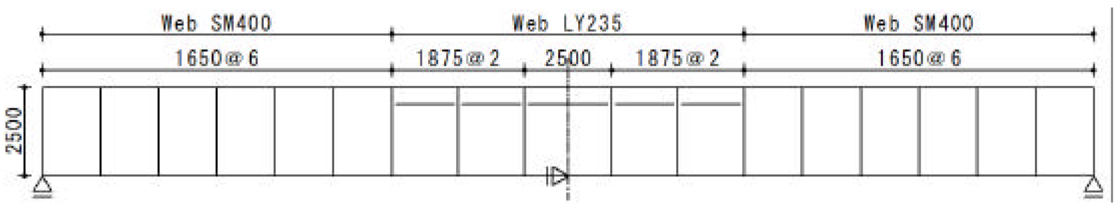

Figure1. The outline of the numerical model

Figure 2 shows the load-deflection relationship of the numerical model in which vertical buckling occurs. Figure 3 shows the deformation pattern of the numerical model at the stage indicated with the black point (?) in the Figure 2.

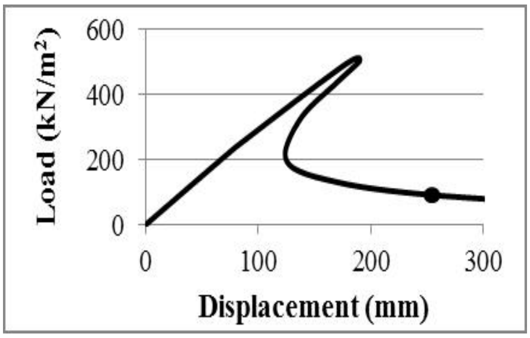

Figure 2. Load-deflection relationship

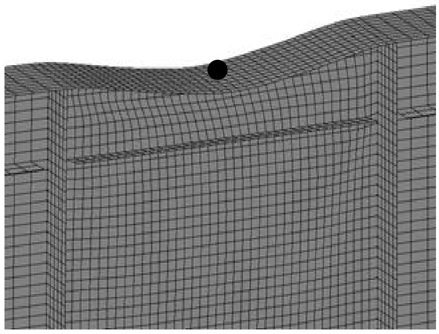

Figure 3. Deformation pattern

After reaching the maximum loading, loading is rapidly decrease. This behavior is similar to author's previous studies, however, the deformation pattern slightly differs. In Fig 4, for the comparison purpose, the typical deformation pattern under the 2-point loading obtained through author's previous study is demonstrated. As it is found in Fig 4, under the 2-point loading, vertical buckling deformation is observed not at the center of the web panel, although the central part deforms in the current model.

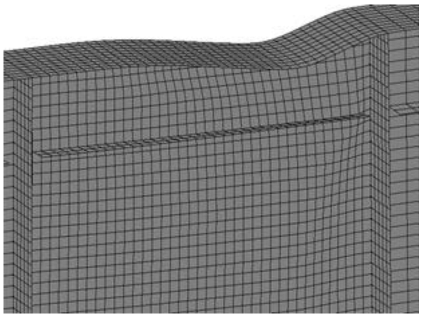

Figure 4. Deformation pattern (2 point loading)

3.CONCLUSION

It is cleared that vertical buckling is occurred under the distributed loading. However, deformation became different from the previous studies .

As with previous studies, buckling collapse behaviour is determined by the relationship between the flange thickness and the web plate thickness.

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