

6.1 IDENTIFICATION OF STEEL BRIDGE MEMBERS

6.1.1 GENERAL

This policy addresses the requirements for identifying and designating a steel bridge member as a Fracture Critical Member (FCM), a Primary Member, or a Secondary Member.

Steel members in newly-designed, widened, strengthened, or seismically-retrofitted bridges must be designated as FCMs, Primary Members, or Secondary Members on the contract plans.

For a widened bridge, a newly-designed structure and the existing structure should be considered as one bridge only if the newly-designed superstructure and the existing superstructure are structurally connected. Otherwise, the newly-designed structure should be considered as a separate structure.

6.1.2 DEFINITIONS

The following terms are defined in the AASHTO BDS (AASHTO, 2017):

Primary Member—A steel member or component that transmits gravity loads through a necessary as-designed load path. These members are therefore subjected to more stringent fabrication and testing requirements; considered synonymous with the term “main member”.

Secondary Member—A steel member or component that does not transmit gravity loads through a necessary as-designed load path.

Fracture-Critical Member (FCM)—A steel primary member or portion thereof subject to tension whose failure would probably cause a portion of or the entire bridge to collapse.

Redundant Member—A member whose failure does not cause failure of the bridge.

System Redundant Member (SRM)—A steel primary member or portion thereof subject to tension for which the redundancy is not known by engineering judgment, but which is demonstrated to have redundancy through a refined analysis.

6.1.3 STEEL MEMBER IDENTIFICATION

6.1.3.1 Fracture Critical Members

The Fracture Critical Member (FCM) designation must only be used for primary members in tension or primary member tension components or zones whose failure would cause a portion of the bridge or the whole bridge to collapse. Redundant members are not FCMs. Redundancy means that should a tension member or tension component fail, the load



carried by the failed member would be redistributed to and carried by remaining members to avoid catastrophic collapse of the structure.

Primary members or portions thereof, including but not limited to the following, must be identified as FCMs only if their failure would cause a portion of the bridge or the whole bridge to collapse:

- Tension ties in arch bridges;
- Tension members in truss bridges;
- Main supporting cables, pins, and hanger assemblies;
- Tension flanges and tension webs in two-girder bridges;
- Tension flanges and tension webs in single or double box girder bridges;
- Tension flanges and tension webs in floor beams/cross girders;
- Tension flanges and tension webs in bent caps; and
- Plastic regions within a seismic load path as specified in *SDSSB* (Caltrans, 2016).

The following members or components should not be identified as FCMs:

- Members or components that are not subjected to net tensile stresses under Strength I Load Combination;
- Compression members and components;
- Attachments welded to the compression areas of bending members; and
- Tension flanges and tension webs in multi-girder (3 girders and more) bridges.

6.1.3.2 System Redundant Members

The System Redundant Member (SRM) is introduced in the *AASHTO BDS*, 8th Edition (AASHTO, 2017). It is a member traditionally designated as an FCM for which the redundancy is not apparent by engineering judgment, but which is demonstrated to have redundancy through a refined analysis. At the design stage, a refined analysis to identify SRMs is not required.

6.1.3.3 Primary Members

The Primary Member must be identified in accordance with Table 6.6.2.1-1 of the *AASHTO BDS* (AASHTO, 2017).

6.1.3.4 Secondary Members

The Secondary Member must be identified in accordance with Table 6.6.2.1-1 of the *AASHTO BDS* (AASHTO, 2017).



6.1.4 DESIGN IMPLEMENTATION

The following designations for steel bridge members must be shown explicitly on the contract plans:

- Fracture Critical Member is designated as FCM.
- Primary Member (Non-Fracture-Critical) subject to a tensile stress under Strength Limit State I Load Combination (Strength I) of the *AASHTO BDS* (AASHTO, 2017) is designated as “T”.
- Primary Member (Non-Fracture-Critical) subjected to only compressive stresses under Strength I of the *AASHTO BDS* (AASHTO, 2017) is designated as “C”.
- Secondary Members need not be designated explicitly. Instead, a note such as “All non-designated steel members are Secondary Members” must be added.
- For a steel girder, when only flanges are designated as “FCM”, “T”, and “C”, a note such as “FCM, T, and C shown are extended to the middle depth of the web” must be added.

6.1.5 REFERENCES

1. AASHTO. (2017). *AASHTO LRFD Bridge Design Specifications*, 8th Edition, American Association of State Highway and Transportation Officials, Washington DC.
2. Caltrans. (2016). *Caltrans Seismic Design Specifications for Steel Bridges*, 2nd Edition, Sacramento, CA.