# Tension Fields in Plate Girders

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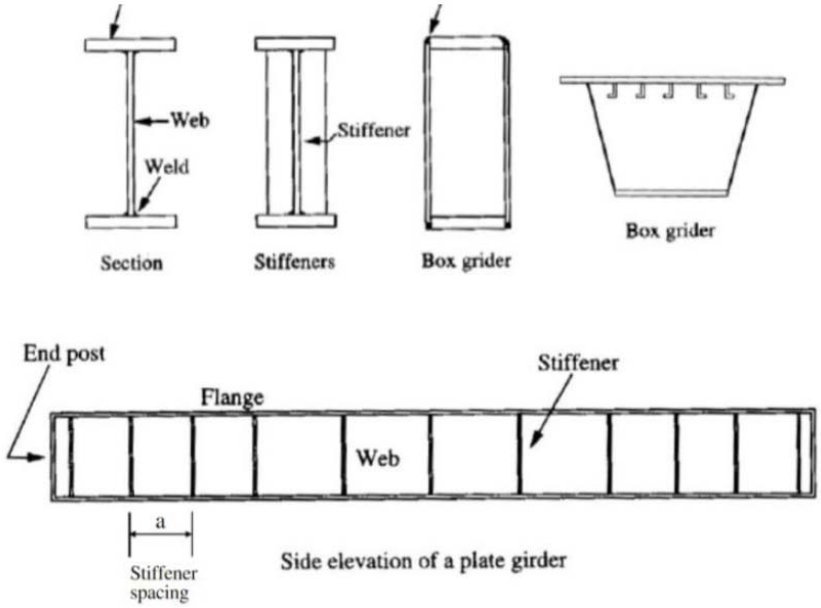
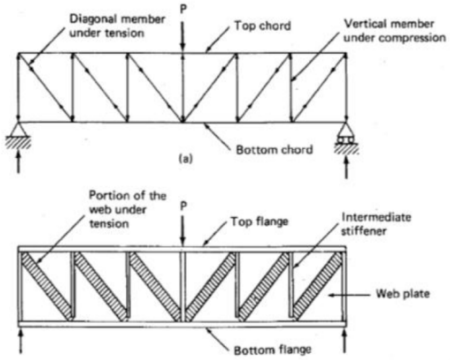
Plate girders offer an economical solution to long spans >15m. Plate girders typically achieve low self-weight to high load resistance ratio. They consist of three plates welded or bolted together to form an I section. Box section, π sections and T sections are also common place.




(Plate Girders, 2008)

By increasing the depth of the beam the Second moment of area ($bd^3/12$) is increased and therefore the section bending moment capacity is increased. Depth of beam should be in the region of 10/span to 20/span (Davidson, Owens 2003). Due to the considerable depth of the member and the requirement for economic solutions the web is slender. If web slenderness exceeds the limits for class 3 semi-compact cross-sections web (clause 3.5 of Eurocode 3) stiffeners are required to transmit shear loading (Davidson, Owens 2003). Localised increase in critical shear strength occurs at the web stiffeners due to improved aspect ratio. Panels of the web between stiffeners utilise the tension field action (Davidson, Owens 2003). Optimum stiffener spacing can be designed so that post-buckling shear capacity is enhanced. Plate girder then behaves analogous to a Pratt truss.




(Chapter 9, 2012)

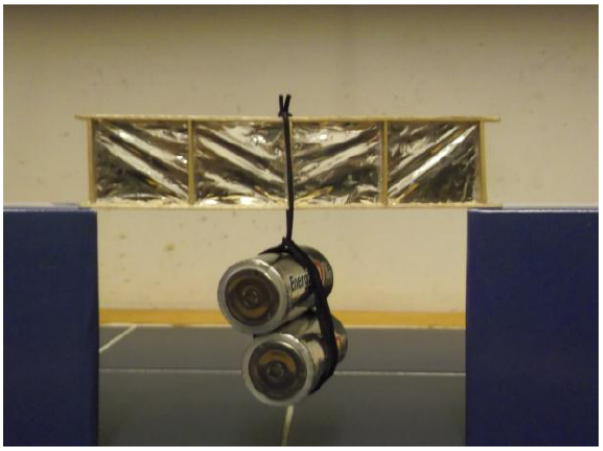
| Advantages | Disadvantages |
|---|---|
| Fabrication and erection of plate girder is easier than that of a truss, and their depth is less so they require less vertical clearance. | Plate girders are heavier than trusses. |
| Plate girders are less sensitive to vibration. | They contribute significant wind loading to the structure. |
| Due to continuous weld of a plate girder there is greater redundancy in the member. | A single poor connection in a statically determinate truss can lead to catastrophic failure. |
| Plate girders are easier to maintain. | |

(Chapter 9, 2012 and Davidson, Owens 2003).

Model demonstration of plate girder.

A timber frame with tin foil web clearly demonstrates tension field concept.

Girder Unloaded



Girder loaded demonstrating tension field in web (model by author)

Plate Girder Examples:

(Topic 20, Plate Girders, 2012)

References

Davidson B, Graham W. Owens (2003) Steel Designers Manual, 6th Edition. Steel Construction Institiute.Silwood Park Ascot SL5 7QN. (Chapter 17)

Topic 20 Plate Girders http://www.engr.mun.ca/~adluri/courses/steel/pptx%20files1/Topic%20-%20Plate%20Girders.pdf accessed on 27/102012

Chapter 9 http://hegl.eng.ohio-state.edu/~eg532/pdf_files/chap9.pdf accessed on 27/102012

Plate Girders http://www.scribd.com/doc/106808648/Plate-Girders-2008 accessed on 27/102012