

Tutorials | 2020

Imperfection Concept - Theoretical Background

Steel Design



Stability verification

Different stability verification methods are provided in EN 1993-1-1.. The goal is the same – to consider the second-order effects and imperfections. EN 1993-1-1 allows several ways to account for the second-order effects and imperfections. Chapter 5.2.2 (3) states:

According to the type of a frame and the global analysis, second order effects and imperfections may be accounted for by one of the following methods:

- A. both totally by the global analysis,
 - B. partially by the global analysis and partially through individual stability checks of members according to 6.3,
 - C. for basic cases by individual stability checks of equivalent members according to 6.3 using appropriate buckling lengths according to the global buckling mode of the structure.
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Stability verification

EN 1993-1-1 chapter 5.2.2 (7) and (8) describes the stability verification for members:

In accordance with chapter 5.2.2 (3) the stability of individual members should be checked according to the following:

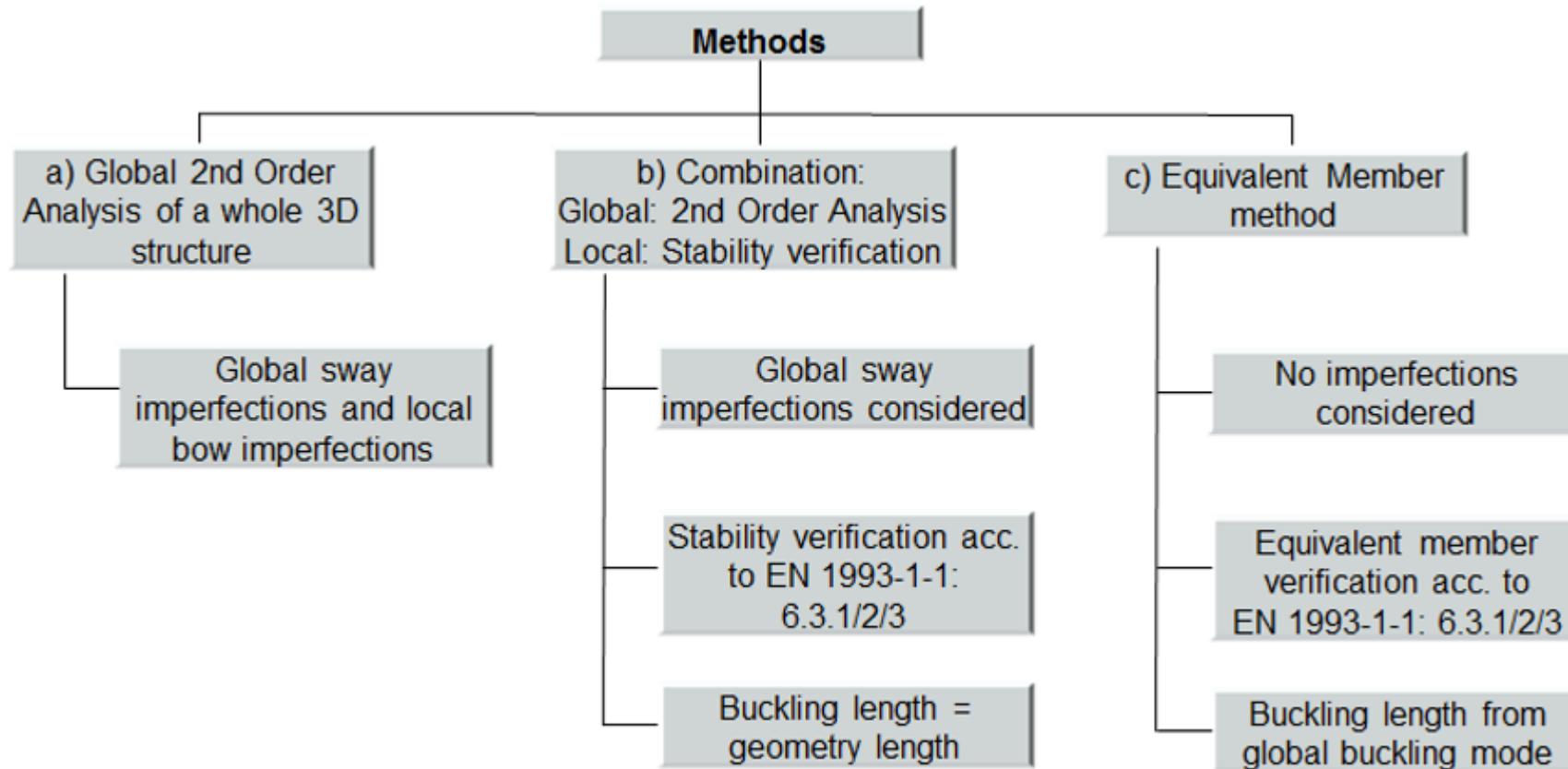
- a) If second order effects in individual members and relevant member imperfections (see 5.3.4) are totally accounted for in the global analysis of the structure, no individual stability check for the members according to 6.3 is necessary.
 - b) If second order effects in individual members or certain individual member imperfections (e.g. member imperfections for flexural and/or lateral torsional buckling, see 5.3.4) are not totally accounted for in the global analysis, the individual stability of members should be checked according to the relevant criteria in 6.3 for the effects not included in the global analysis. This verification should take account of end moments and forces from the global analysis of the structure, including global second order effects and global imperfections (see 5.3.2) when relevant and may be based on a buckling length equal to the system length.
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Stability verification

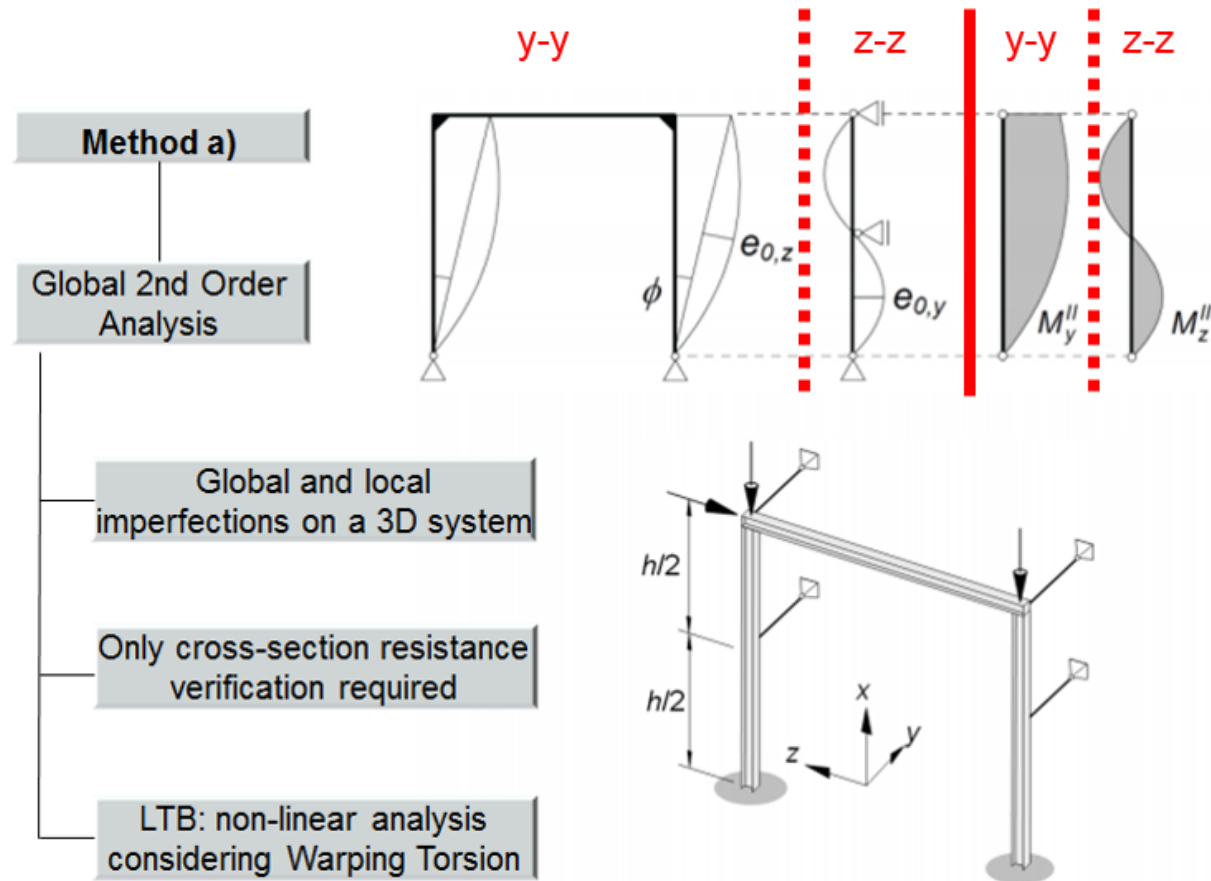
A clear presentation of the mentioned methods has been published in “Deutscher Stahlbautag 2012; Aachen, 18. Oktober 2012” by Prof. Dr.-Ing. Ulrike KUHLMANN, Dr.-Ing. Hans-Peter GÜNTHER and Dipl.-Ing. Antonio ZIZZA. The methods are the following:

- + Method a)
 - + Method b1)
 - + Method b2)
 - + Method c)
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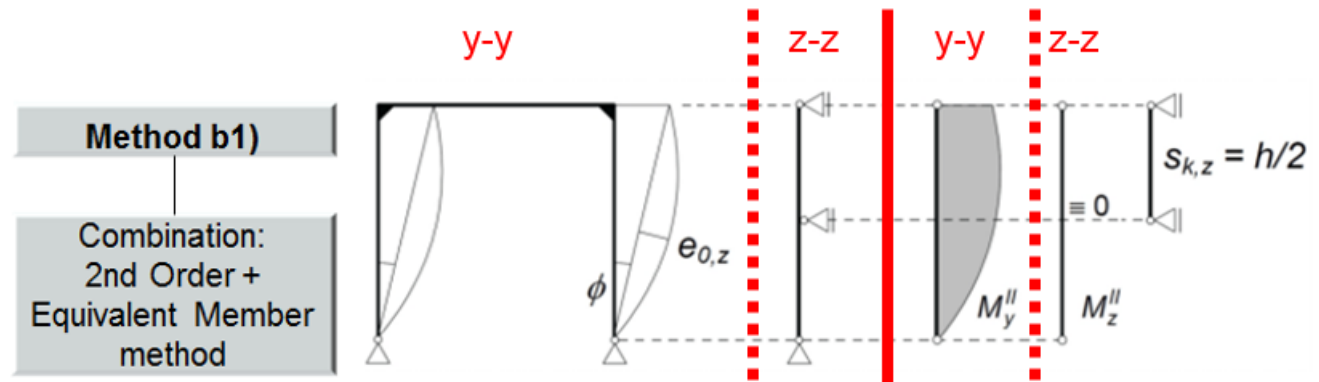
Stability verification



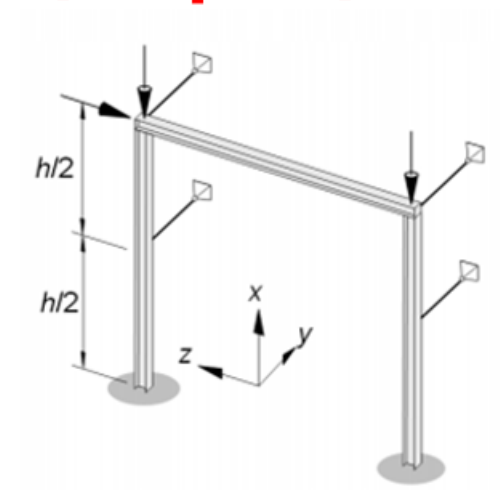
Stability verification



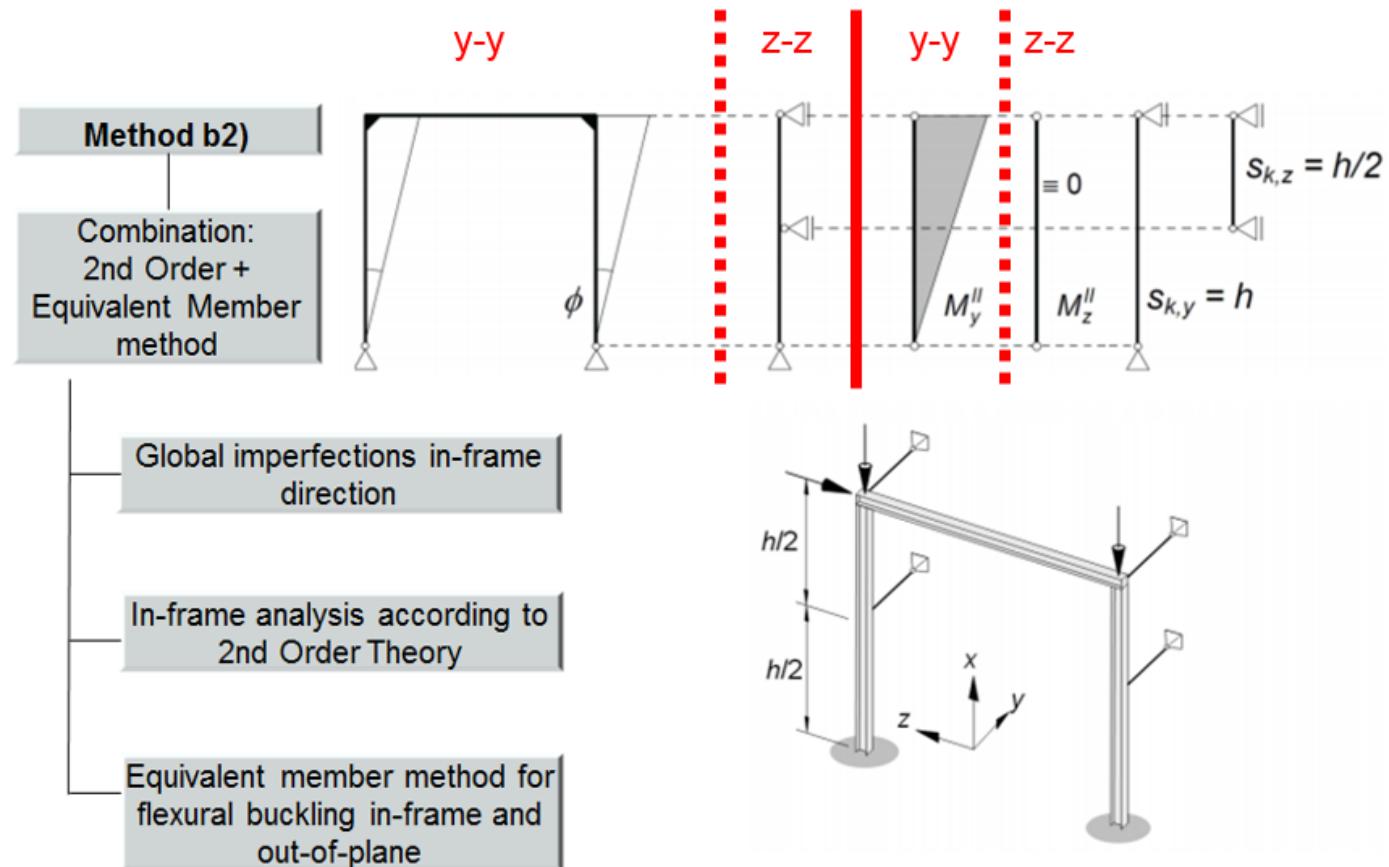
Stability verification



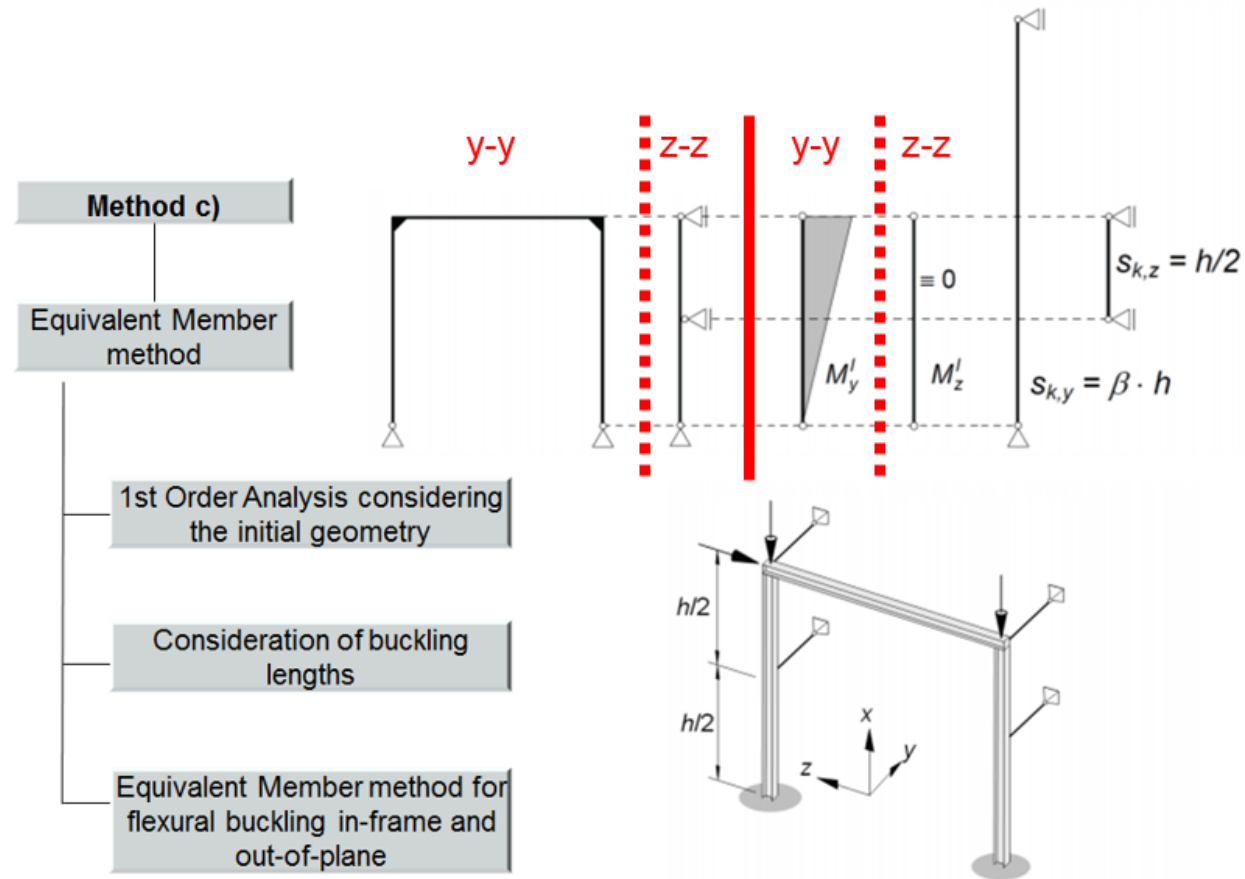
- Global and local imperfections in-frame direction
- In-frame analysis according to 2nd Order Theory
- Equivalent Member method for flexural buckling out-of-plane



Stability verification



Stability verification



Thank you for your attention

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