

# Using Eurocodes to Design Stainless Steel Bridges

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Stainless Steel in Structures:  
Fourth International Experts Seminar

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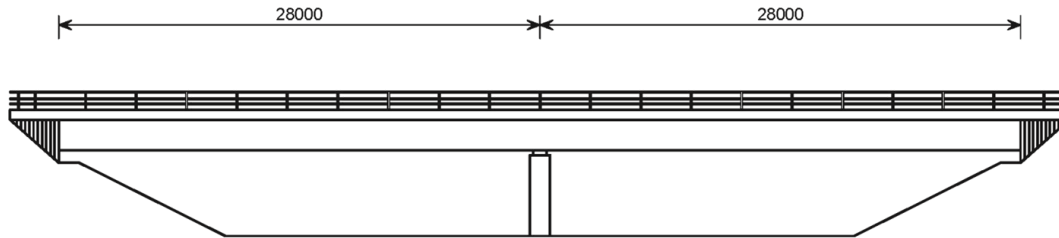
# Stainless Steel Bridge Study

- Client: Outokumpu
- Steel composite highway bridge
- Eurocodes
- Construction costs
- Life-cycle costs
- Optimisation

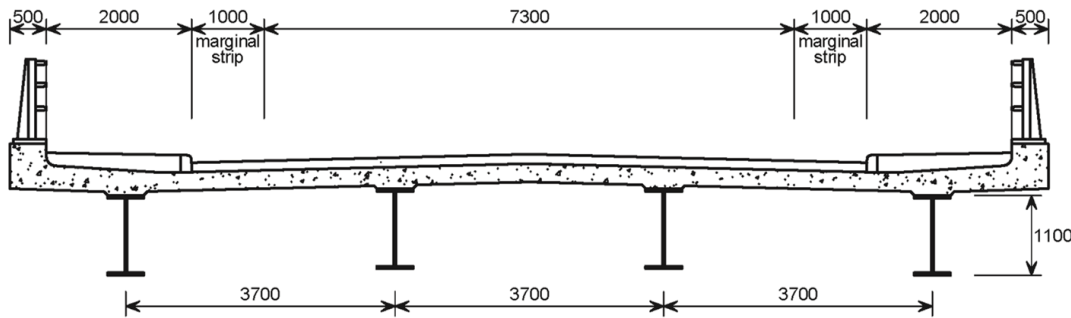
*Nynäshamn bridge, Sweden*



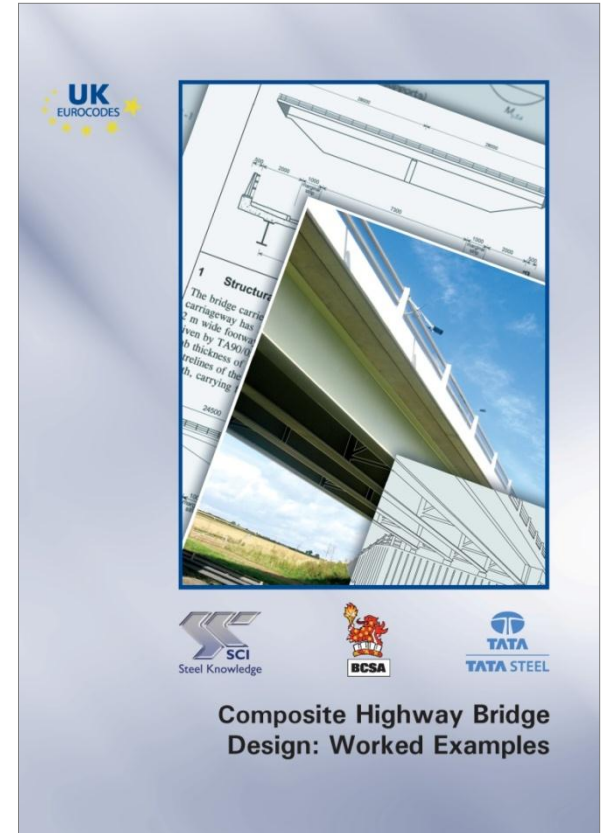
# Study - Reference Design



*Elevation*



*Cross section*



*SCI Publication 357 – Composite Highway Bridge Design: Worked Example*

# Optimisation

- Remove material inefficiency
- Fully effective elements ( $\chi = 1$ )
- Class 2 (Compact) sections
- Member buckling restraint
- Extra fabrication to remove excess material

# Stainless Steel Structure

- 1993-1-1 basic design rules for steel structures
- 1993-1-5 requirements of stiffened and unstiffened plates
- 1993-1-4 supplementary provisions that extend and modify 3-1-1 and 3-1-5 to stainless steels.

# Steel Bridge

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- 1993-1-5 requirements of stiffened and unstiffened plates
- 1993-1-4 supplementary provisions that extend and modify 3-1-1 and 3-1-5 to stainless steels.
- 1993-2 general basis for the structural design of steel bridges.

It gives provisions that supplement, modify or supersede the equivalent provisions given in the various parts of EN 1993-1.

# Stainless Steel Bridge?

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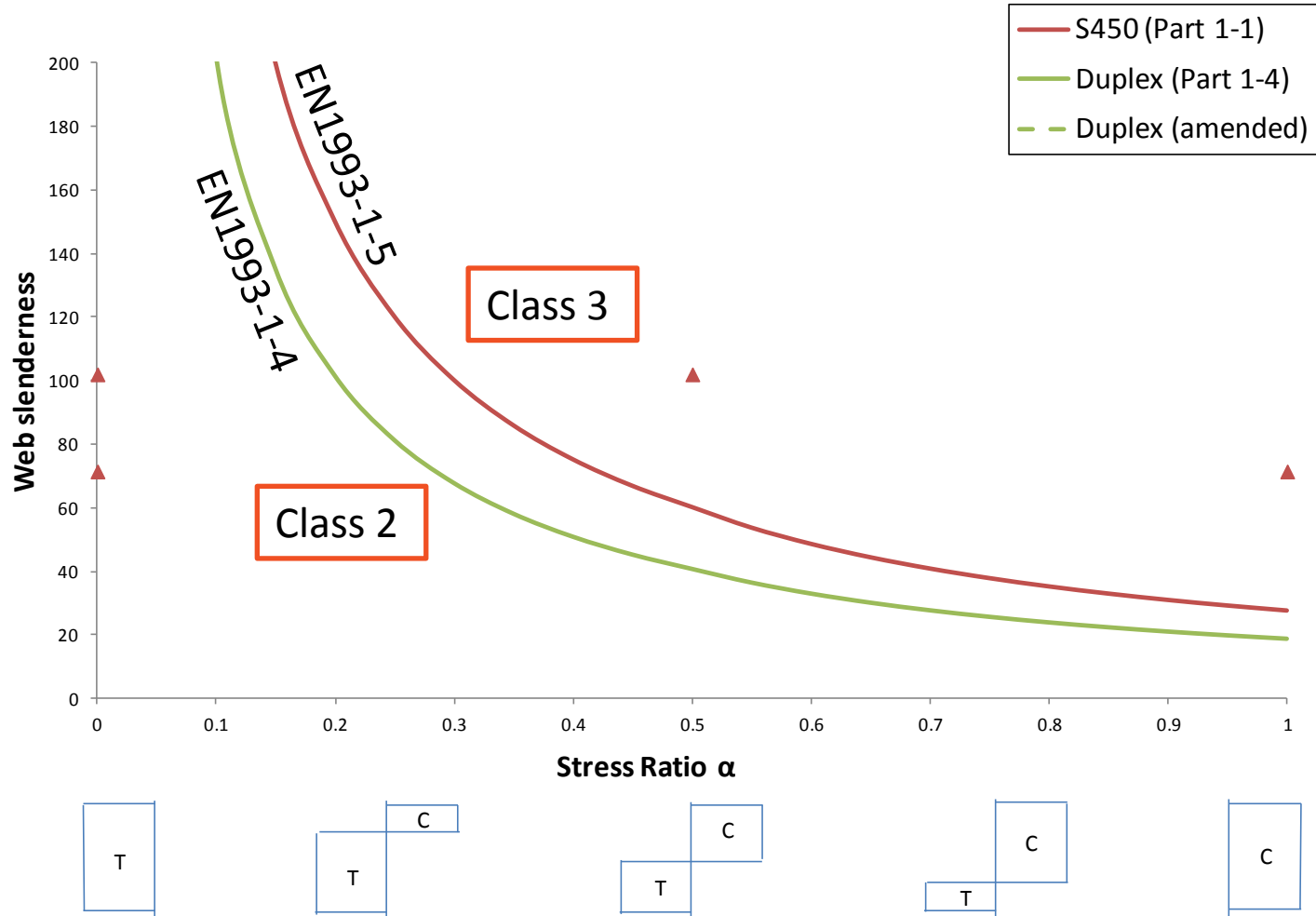
# Eurocodes

	<b>General Rules</b>	<b>Stainless Steel</b>	<b>Bridges</b>
	1993-1-1 1993-1-5	1993-1-4	1993-2
Shear area factor, $\eta$	1.2	1.2	-
Partial factor for X-sections, $\gamma_{M0}$	1.0	1.1	1.0
Partial factor for members, $\gamma_{M1}$	1.0	1.1	1.1



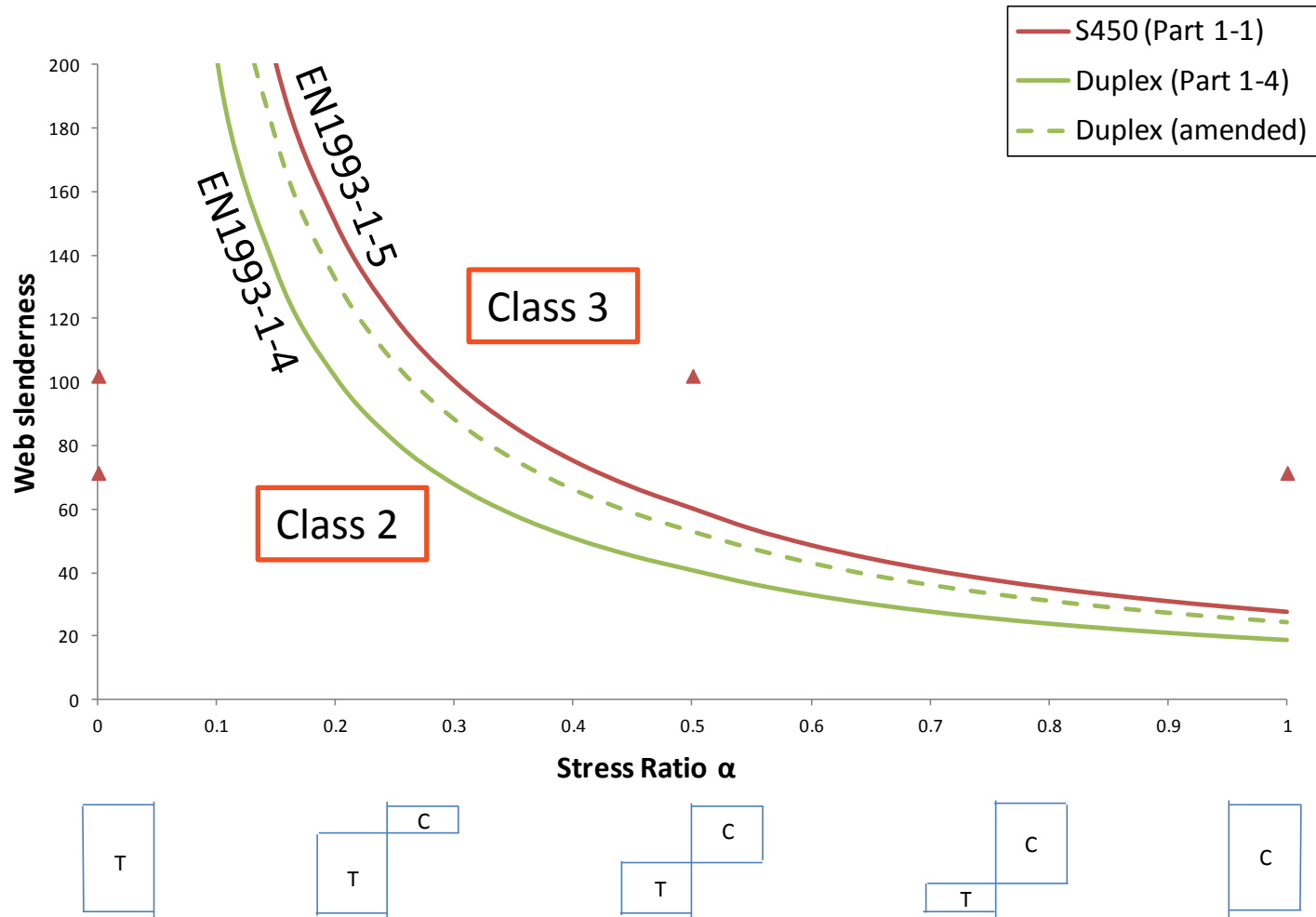
# Shape Limits – web in compression

c/t limit for class 2 web



# Shape Limits – web in compression

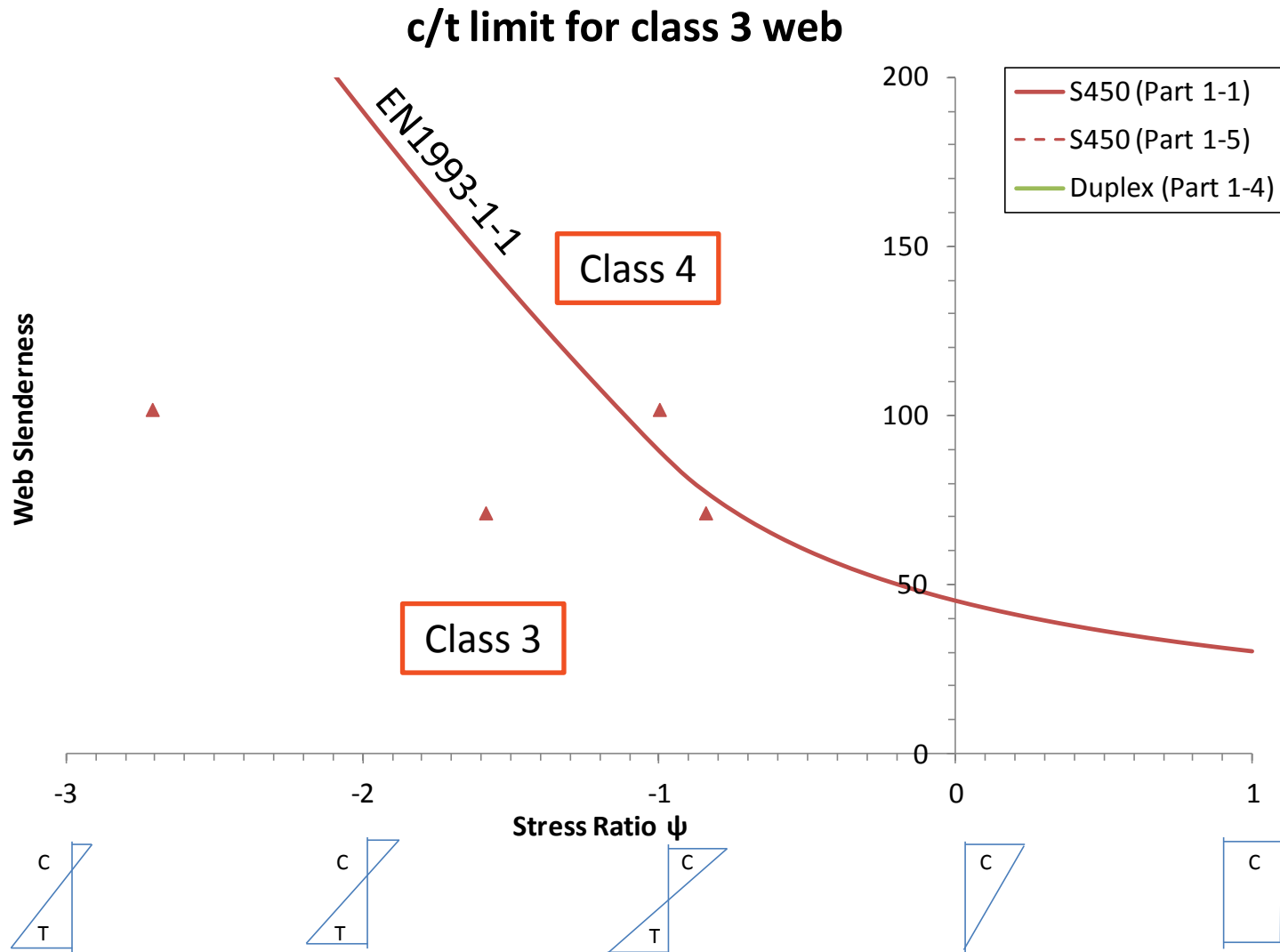
c/t limit for class 2 web



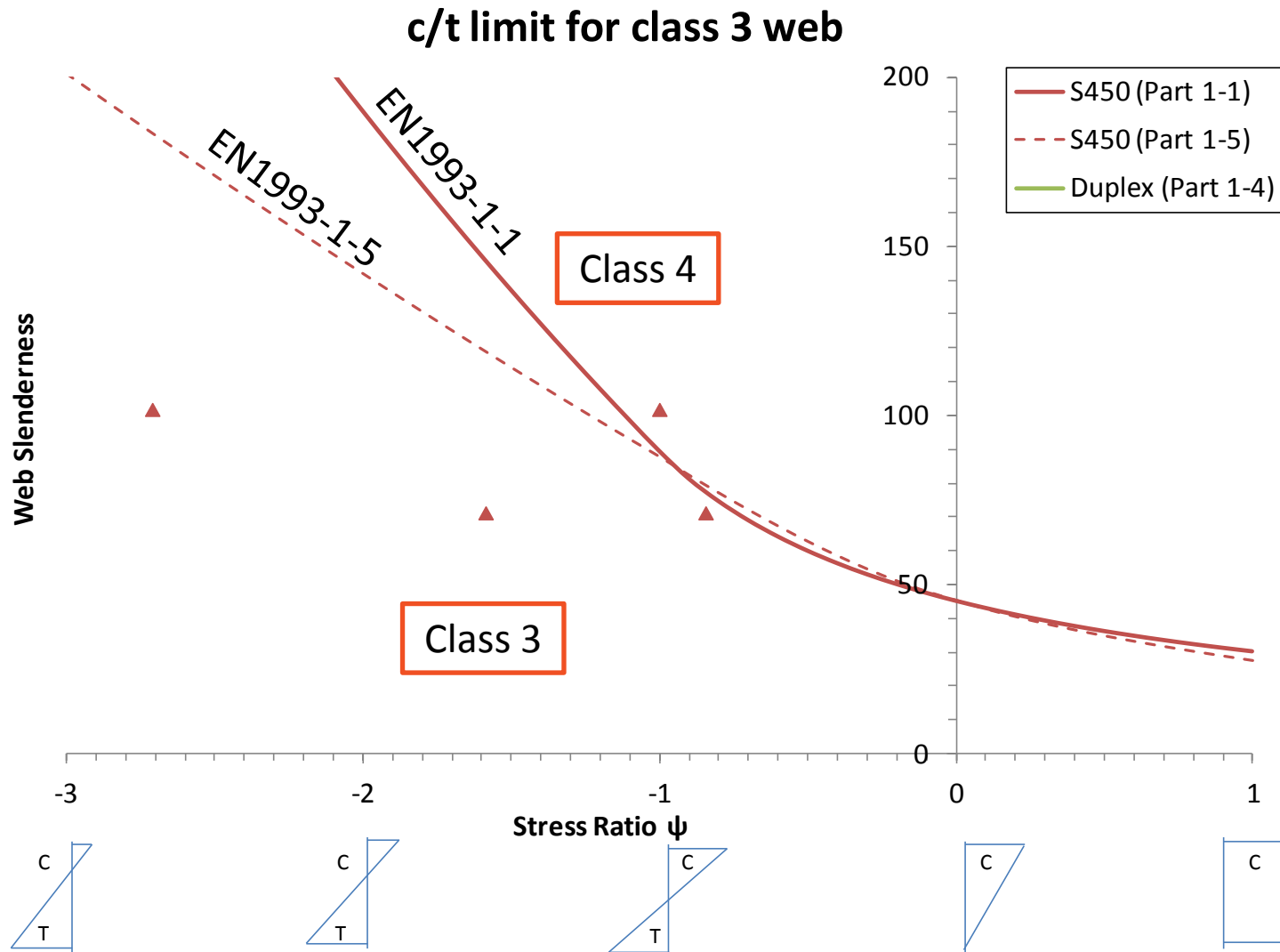
# Shape Limits – web in compression

**c/t limit for class 3 web**

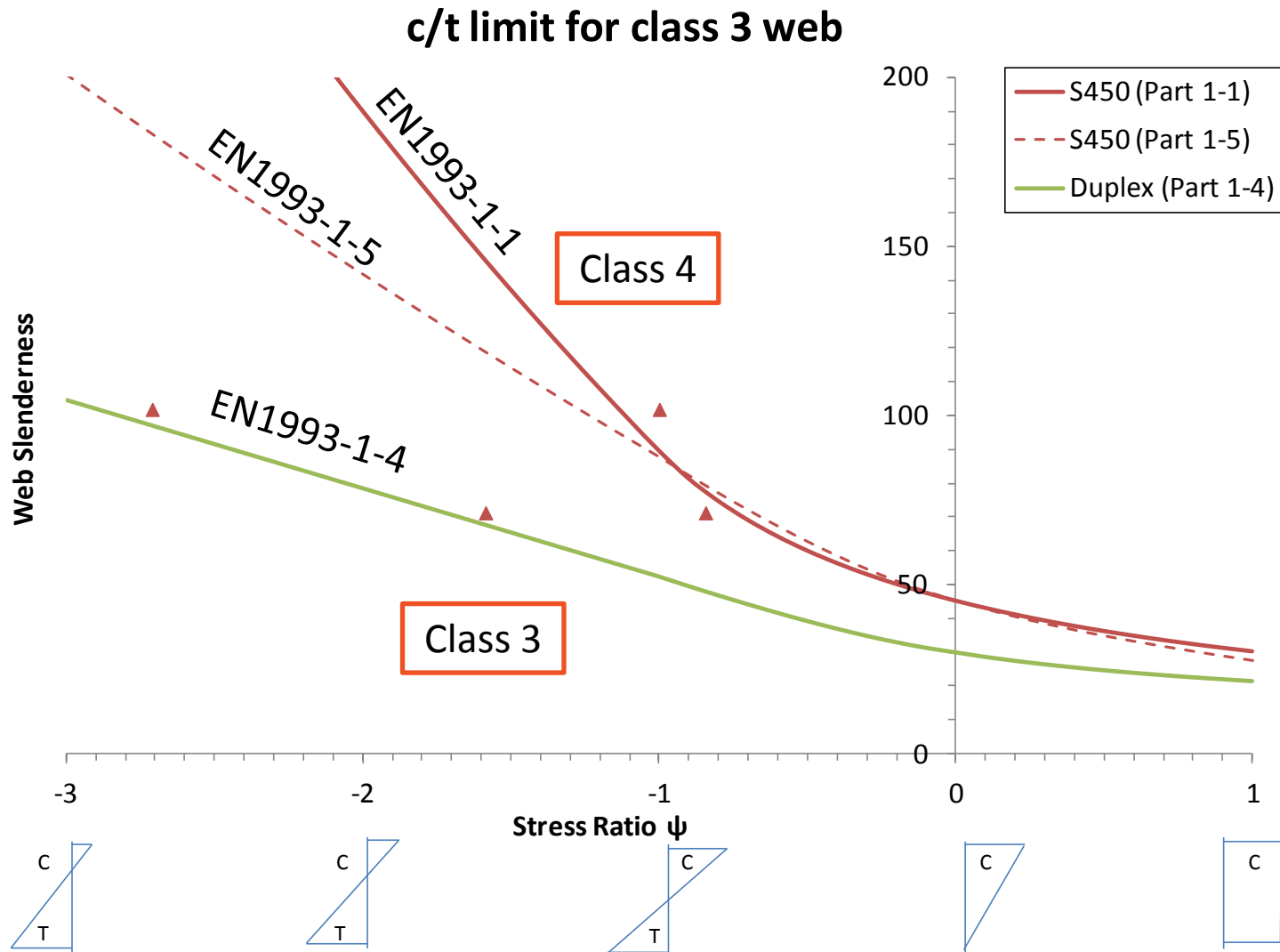
# Shape Limits – web in compression



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# Shape Limits – web in compression



# Slip Resistant Connections

- Widely used in steel bridge construction
- Bolt relaxation
- Slip factor
- Thread galling

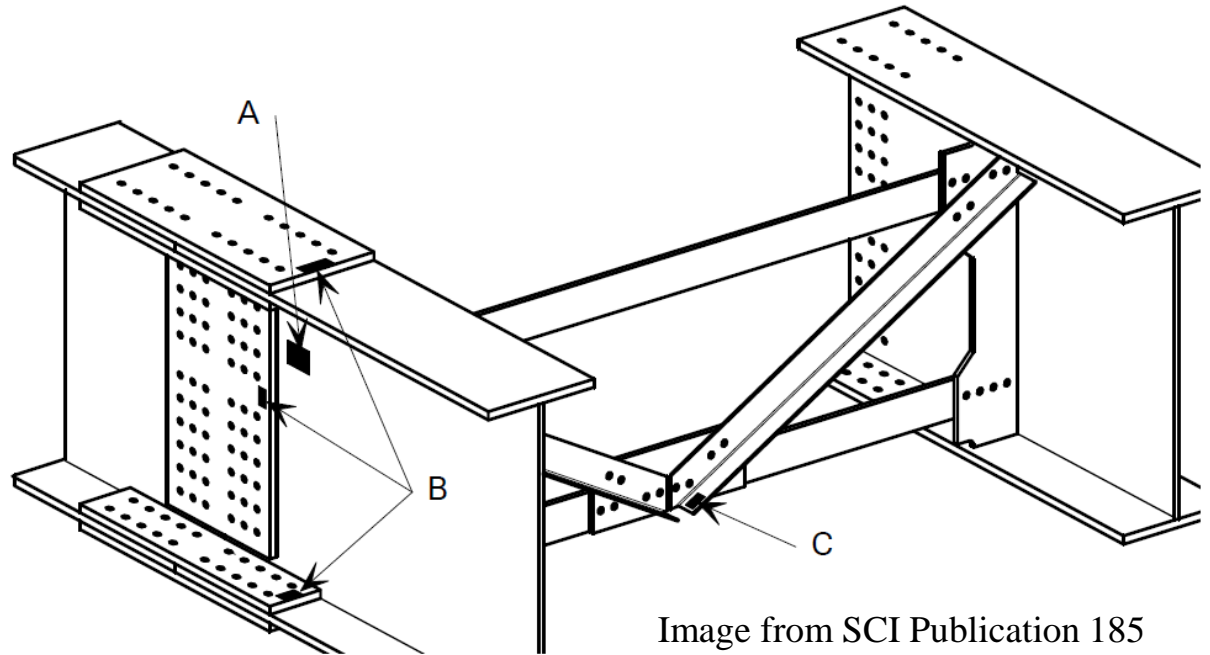


Image from SCI Publication 185

# Summary

- Optimise design for stainless steel
- Eurocodes provides all the tools
- Stainless Steel Structure or Steel Bridge?
- Partial safety factors
- Web in compression shape limits
- Slip resistant connections

Thank you