

Note on Engineering Details

No: DWR-Han-extern-001

Title: **Fatigue-verification of embedded steel section / welded connection between shell and bottom flange**

Ref.: GL "Guideline for the Certification of Wind Turbines", Edition 2003 with Supplement 2004, 5.3.3.4.1.

DIN EN 1993-1-9:2005

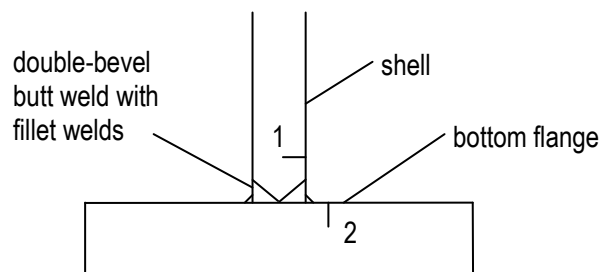
Contact: Klaus Hansen, e-mail: klaus-georg.hansen@gl-group.com, phone: +49 40 36149 4092

Key Words: bottom flange, steel section, welding seam, nominal stress method, geometrical stress method, hot spot method, thickness correction

According to our "Guideline for the Certification of Wind Turbines", Edition 2003 with Supplement 2004, section 5.3.3.4.1, the detail category selection for the fatigue analysis shall be in accordance with Eurocode 3 (EC 3).

The current version of EC 3 is DIN EN 1993-1-9:2005. The detail categories which have to be applied for the fatigue verification (nominal stress method) are listed in section 8 of DIN EN 1993-1-9:2005. Alternatively, the geometrical (hot spot) stress method can be applied, see annex B of DIN EN 1993-1-9:2005.

Regarding the fatigue verification of the welded connection between shell and bottom flange of the embedded steel section the following annotations have to be considered:



1. Nominal stress method / detail category to be applied:

1.1 Verification of shell / 'horizontal crack' (1):

The verification has to be based on DIN EN 1993-1-9:2005, table 8.5, construction detail 1.

1.2 Verification of bottom flange / 'vertical crack' (2):

A corresponding construction detail is not explicitly shown in DIN EN 1993-1-9:2005.

In the past the fatigue verification of the bottom flange has been carried out based on detail 20.2 of DIN V ENV 1993-3-2:1997 (detail category 90).

According to our experiences with calculations based on the geometrical stress method under the terms of DIN EN 1993-1-9:2005 detail category 90 can be confirmed in general for conventional dimensions of the steel section (thickness of bottom flange significantly higher than thickness of shell).

Therefore detail category 90 is accepted for the verification.

2. Geometrical (hot spot) stress method / thickness correction factor:

In contrast to the nominal stress method DIN EN 1993-1-9:2005 does not contain a regulation how to consider the influence of plate thickness when using the geometrical (hot spot) stress method.

In this context the 'Recommendations for fatigue design of welded joints and components' of the International Institute of Welding (IIW), version December 2008, can be regarded as state of the art: Accordingly a thickness correction has to be considered for the fatigue verification; for details see 'Recommendations for fatigue design of welded joints and components' of the International Institute of Welding (IIW), version December 2008.

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Christian Nath
Vice President Renewables Certification

Dr. Torsten Faber
Head of Department

Stefan Baars
Head of the Group

Andreas Anders
Head of Department

Mike Woebbeking
Head of Department

Klaus Hansen
Author