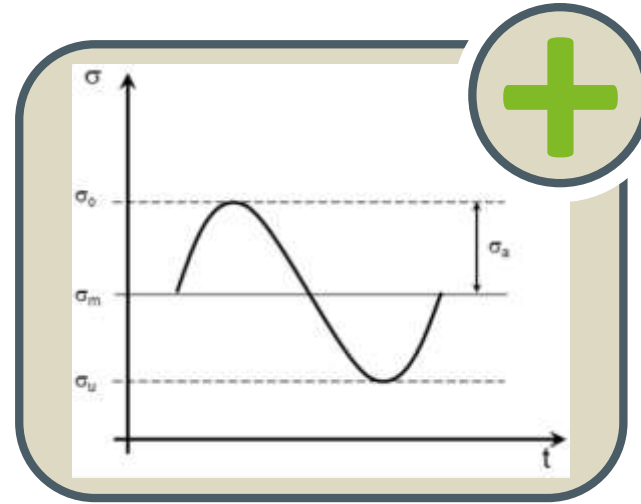
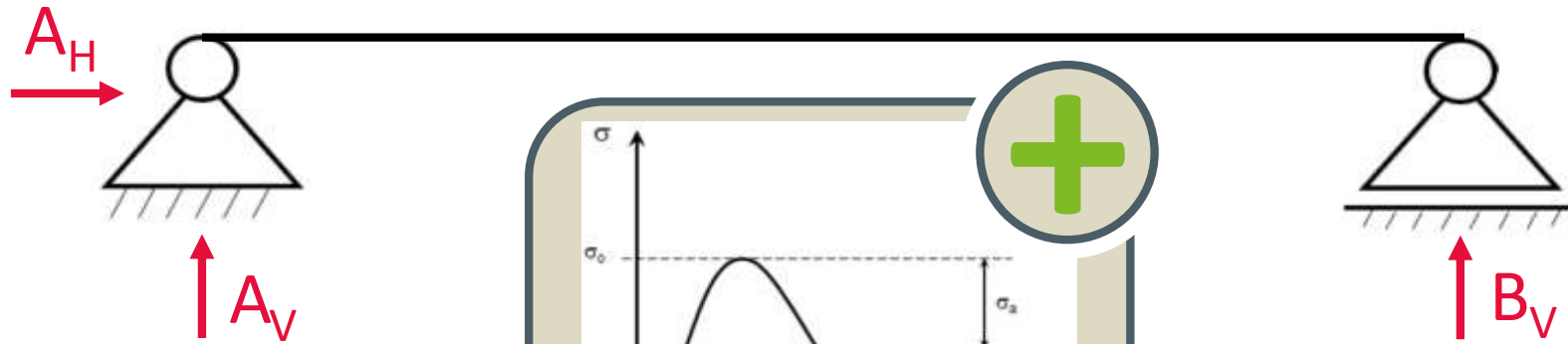




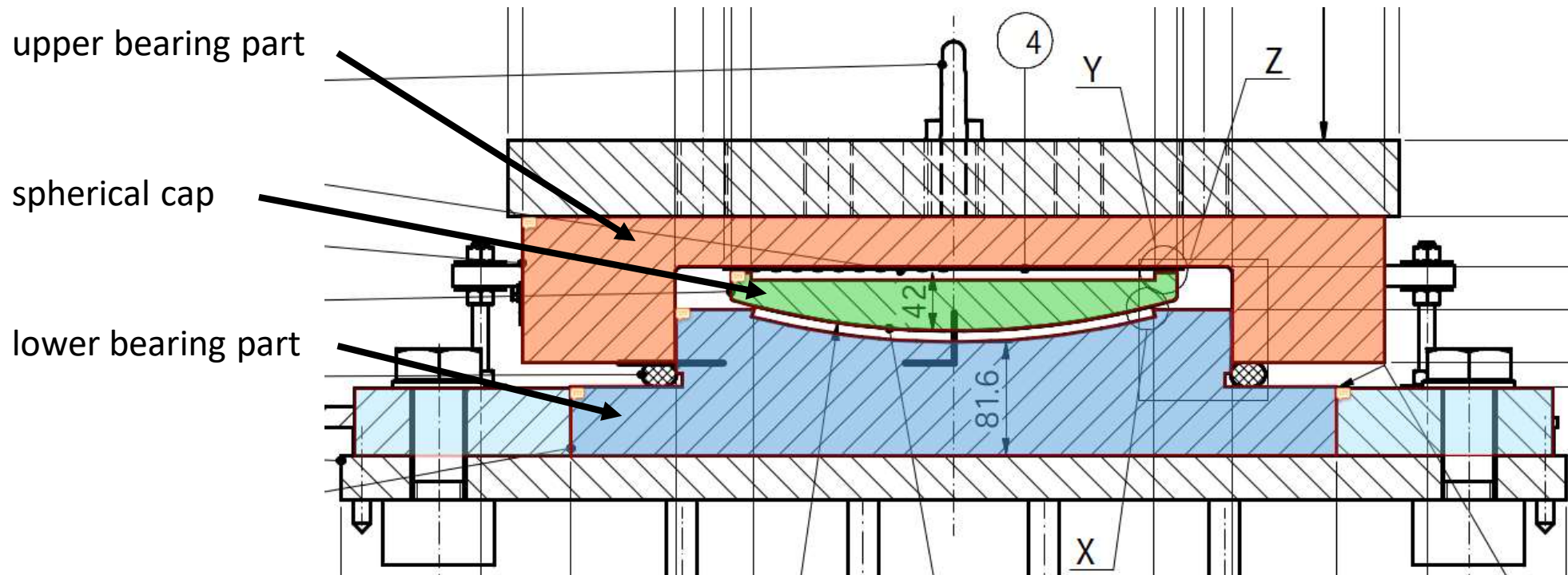
**Material selection for railroad bridge bearings to avoid brittle fracture**  
**- Steel Bridges Symposium Prague 2024 -**



## Obvious need of a sufficient brittle fracture design



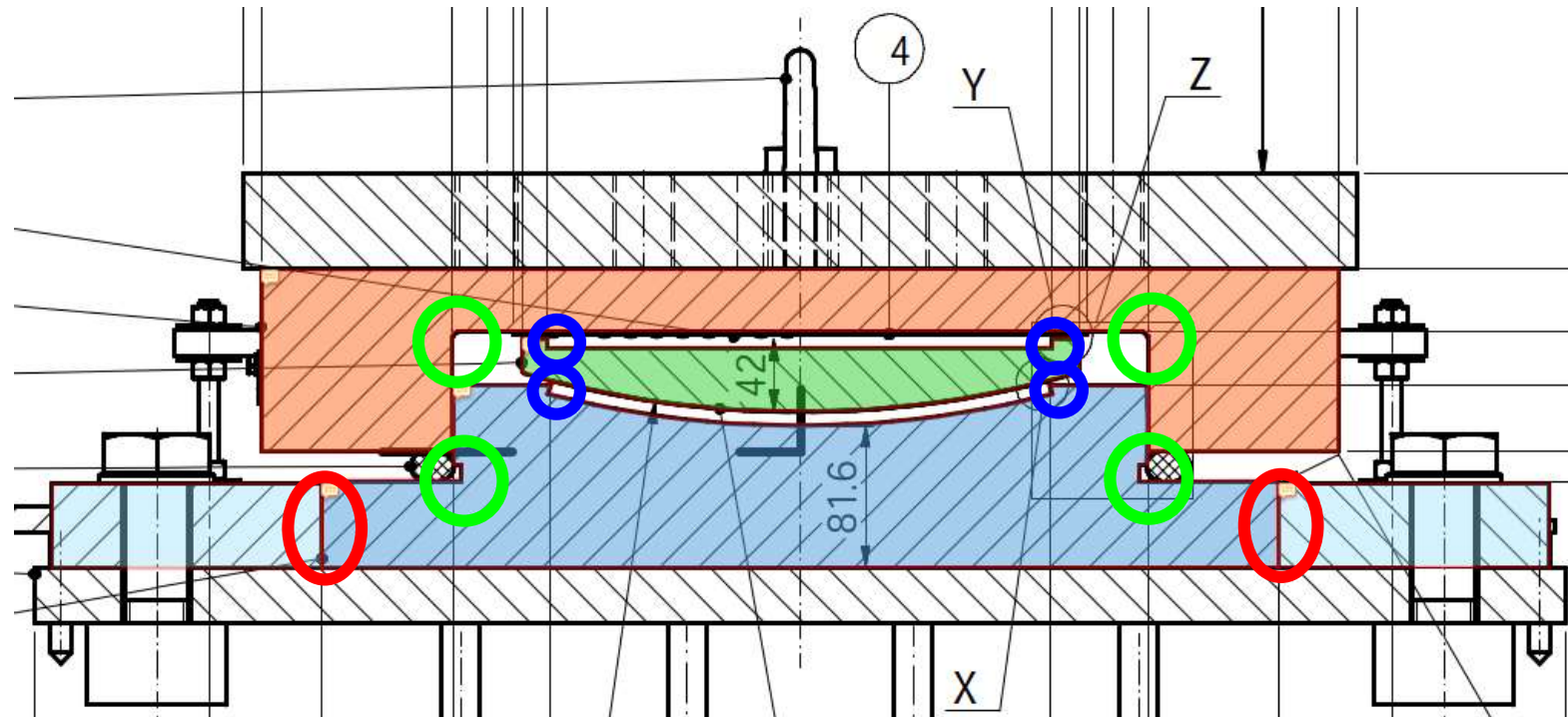
## Identification of standard bearing components



## Influence parameters of brittle fracture

influence parameters		brittle fracture-promoting parameters
stress	loading conditions	<ul style="list-style-type: none"> <li>• low temperatures</li> <li>• sudden loading</li> <li>• multiaxial stress state</li> </ul>
	environmental conditions	<ul style="list-style-type: none"> <li>• stress corrosion cracking</li> <li>• liquid metal embrittlement</li> <li>• hydrogen embrittlement</li> </ul>
construction	design	<ul style="list-style-type: none"> <li>• notches</li> <li>• sudden changes in cross-section</li> <li>• thick-walled components</li> </ul>
material	manufacturing technology	<ul style="list-style-type: none"> <li>• surface defects and cracks due to welding</li> <li>• hardening</li> <li>• grinding</li> </ul>
	material structure and microstructure	<ul style="list-style-type: none"> <li>• cubic body-centered and hexagonal crystal lattice</li> <li>• coarse-grained</li> <li>• impurities</li> <li>• non-metallic inclusions</li> </ul>

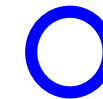
## High risk for brittle failure



Welds:



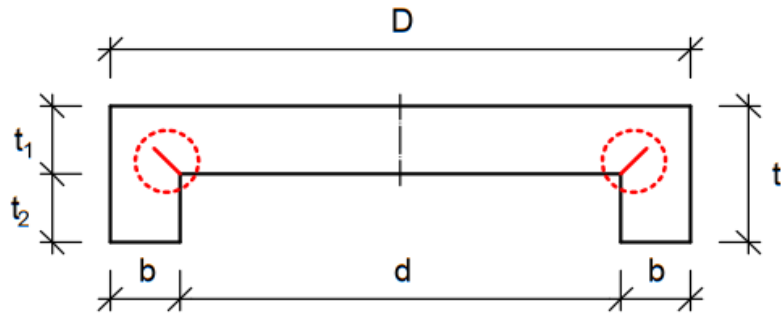
Sharp edges:



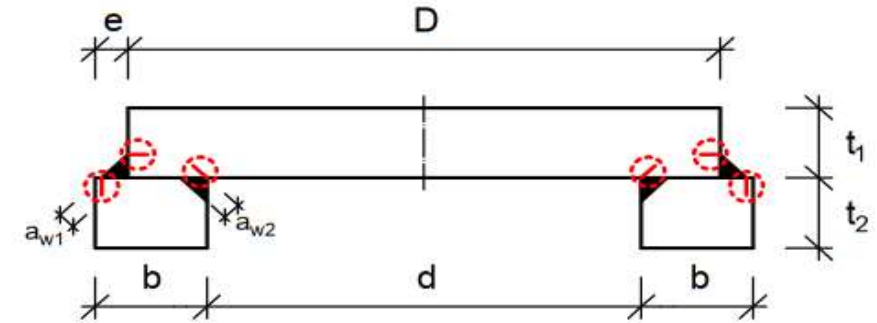
Edges:



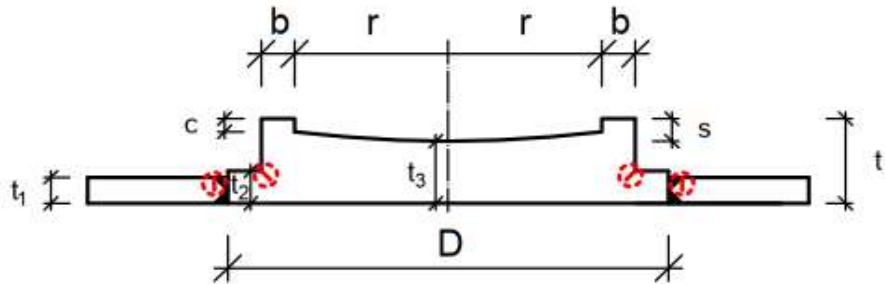
## Typical bearing details and assumption for possible crack initiation



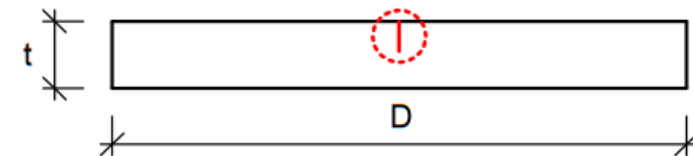
Upper part of a bearing (milled from the solid)



Upper part of a bearing (welded solution)

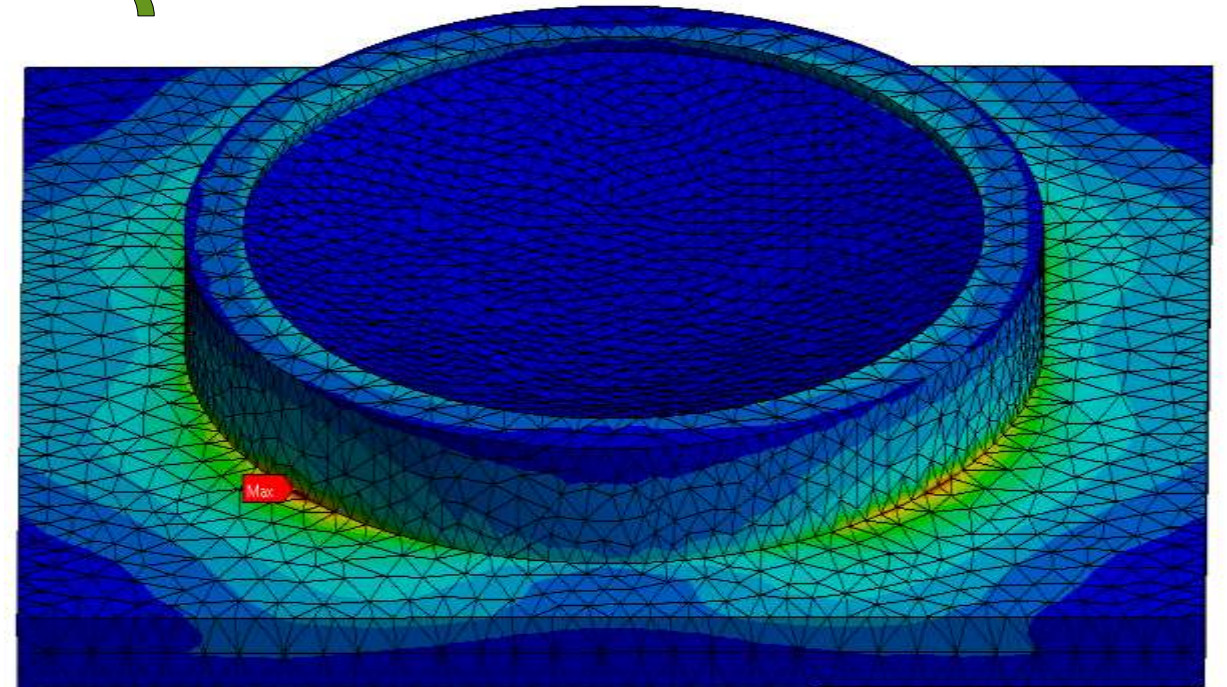
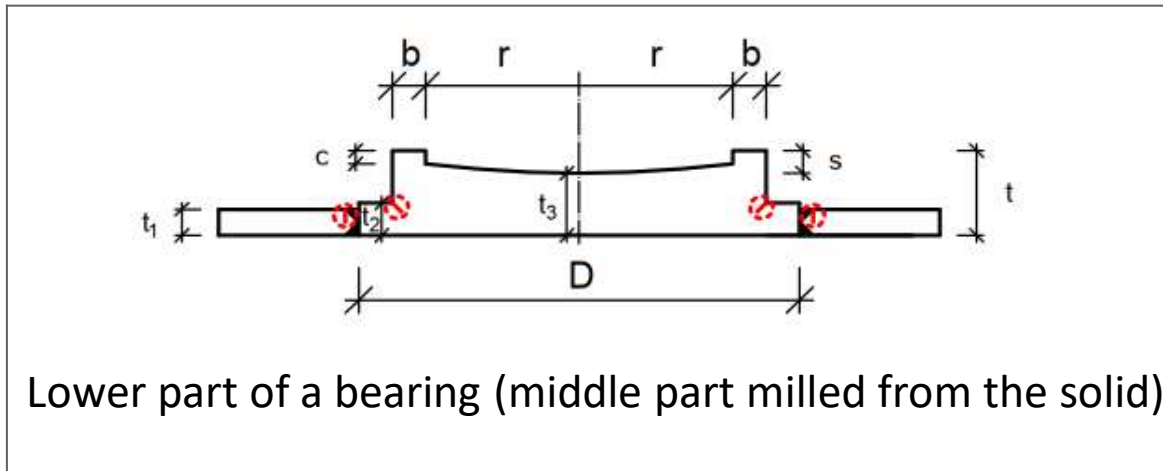


Lower part of a bearing (middle part milled from the solid)



Anchor plate (milled from the solid)

## Verification of selected standard details





## Experimental investigations - full scale tests

a)

### Pre-test:

- 1) Special laser-cutting to apply initial damage at critical hot-spot
- 2) Application of specific fatigue load to induce fatigue crack

b)

### Main brittle fracture test:

- 3) Cooling down specimens with induced crack to specific low temperature
- 4) Increasing quasi-static load till failure



**DB NETZE**

DB Netz AG  
ZENTRALE

Allgemeingültige Technische Mitteilung	
- Als Handlungsanweisung gemäß Konzernrichtlinie 138.0202 -	
TM 2012-048 I.NVT 4	
Sachlich zugehörige RfI:	804
Ersatz für TM :	
Hinterlegt in der Datenbank: Techn. Mitteilungen DB Netz	Server: BLNSLRW012/DB AG/DE Dateiname: ba412a/tdiskussion/techmitteilnetz.pdf

Thank you for your kind attention  
+  
Many thanks to DZSF for funding  
and to partners for cooperation

Deutsches Zentrum für  
Schienenverkehrsforschung beim



Eisenbahn-Bundesamt



**THM**

TECHNISCHE HOCHSCHULE MITTELHESSEN

**CAMPUS  
GIESSEN**

**BAU**  
Bauwesen



**IWT**  
Solutions AG

Ingenieurbüro  
Dr.-Ing. Markus Porsch