

INVITATION

Symposium
on
Structural Durability
in
Darmstadt



June 9–10, 2005
Darmstadt, Germany
Orangerie



TECHNISCHE
UNIVERSITÄT
DARMSTADT



Fraunhofer

Institut
Betriebsfestigkeit
Systemzuverlässigkeit



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Preface

For more than half a century, Darmstadt has been a centre of essential expertise in structural durability. The institutions involved in both research and design, cover areas ranging from material science and mechanics of materials, to application in mechanical and civil engineering. Test and measurement equipment, computational methods and design philosophies have been developed. To illustrate the continuity of activities in this field several institutes and companies have grouped together to initiate the 'Symposium on Structural Durability' in Darmstadt. The symposium is organised by:

The objective of the 'Symposium on Structural Durability in Darmstadt' (SoSDiD) is to present the current 'state of the art' to the national and international fatigue community. Contributions have been gathered from German and international experts and Darmstadt research work in structural durability. The symposium is intended to supply a lively forum for discussing basic questions and actual trends, bringing together scientists and engineers working in this field.

In order to express respect for the founders of the Darmstadt structural durability tradition the sessions have been titled: The *Kurt Klöppel*, *Ernst Gaßner*, and *August Thum* sessions. According to their main research focus, lectures predominantly dealing with *welded structures* are considered in the Klöppel session, those dealing with *mechanical engineering structures* are grouped in the Gassner session, and the Thum session deals with the *material science related aspects* of structural durability.

Institut für Werkstoffkunde/Staatliche Materialprüfungsanstalt Darmstadt (IfW/MPA)

Fraunhofer-Institut für Betriebsfestigkeit und Systemzuverlässigkeit/ Fachgebiet Systemzuverlässigkeit im Maschinenbau (LBF/SzM)

Institut für Stahlbau und Werkstoffmechanik (IFSW)

Instron Corporation (IMT)

Hottinger Baldwin Messtechnik GmbH (HBM)

in collaboration with MatForm

Awards

The Instron Corporation and the Hottinger Baldwin Messtechnik GmbH, will present awards for outstanding work on structural durability among Darmstadt's young engineers and scientists. Both awards will be presented at the symposium.

Proceedings

All papers will be published in the proceedings, which will be given out at the conference.

Advisory Board

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Who is who?



August Thum

In 1927 Professor August Thum (1881–1957) was appointed to hold the newly founded Chair of Materials at Darmstadt University of Technology in combination with the direction of the State Materials Testing Institute Darmstadt (founded in 1907). Within his professorship he was also doctor thesis supervisor of Ernst Gaßner in 1941.

In his basic teachings Professor Thum defined “Gestaltfestigkeit” (shape-related strength) generally as strength, which depends on loading conditions (level and type of load) as well as on material and engineering design. Other subjects of his research work include the effect of residual stresses on the fatigue strength, fatigue notch factors and notch sensitivities of different materials, creep behaviour of heat-resistant steels, fatigue of metals under corrosive conditions and strength of plastics. Furthermore, Thum studied the effects of impact loading and bolts with waisted shanks as an exemplary application for improved component properties. He investigated cast crank shafts as an alternative to forged crank shafts and methods for their surface hardening.

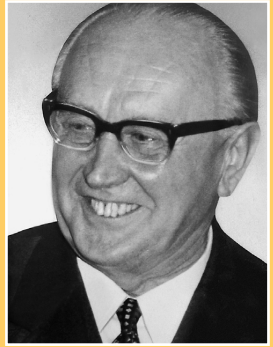
Together with his collaborators, Thum published numerous papers with important contributions to the basic fatigue behaviour of materials in general and more detailed to the fatigue behaviour of many special components such as axes, crank shafts, bolts, springs, gears and welded joints.

Kurt Klöppel

Professor Kurt Klöppel (1901–1985), was appointed full professor of statics and steel construction at the Technical University of Darmstadt in 1938. Around the same time, the introduction of the welding technology made new demands on the materials used and on the related knowledge, due to the danger of brittle failure and fatigue. Conclusions from several failures had to be drawn. Besides statics and steel construction, Kurt Klöppel’s research work ranged from the theory of stability to plasticity, composite structures, welding technology, and reliability. Moreover, he developed a special passion for “Betriebsfestigkeit” (Structural Durability) and was a member of the LBF Advisory Board during the directorship of Ernst Gaßner.

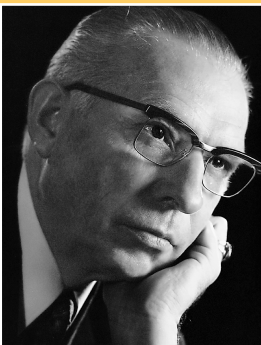
Based on results of experimental investigations, he started publishing allowable stresses for design details used especially in overhead cranes and railway bridges. In 1958 he postulated the durability analysis for variable amplitude loading as a major task for the future generation of engineers.

Furthermore, he strongly promoted the development of theories based on the mechanics of materials. Already in the early sixties he noticed the importance of cyclic plastic deformation at notches and performed studies on fatigue crack growth. Therefore, he can be seen as one of the early masterminds of today's fatigue assessment concepts.



Ernst Gaßner

Professor Ernst Gaßner (1908–1988), one of the founders of LBF, lived and researched in Darmstadt. In the thirties, after his studies at the Technical University of Darmstadt and PhD work under the supervision of Professor August Thum, he coined 1941 the term “Betriebsfestigkeit” (Structural Durability).



In 1939 he first formulated a procedure for the experimental simulation of variable amplitude loadings: the historical 8 step blocked program test with a Gauss-like distribution. (The block program was replaced in the sixties by random loading, due to the development of servo-hydraulic testing facilities.)

Ernst Gaßner who headed the LBF from 1939 to 1973 defined structural durability as the ability of a structure or a component to withstand random cyclic loads that occur during service, taking into account the environmental conditions such as temperature or corrosion. Part of the spectrum can exceed the high-cycle constant amplitude fatigue strength in order to achieve light-weight design and the required service mission can still be fulfilled.

Gaßner's knowledge decisively contributed to the science of light-weight fatigue design and to optimizing the durability of industrial products, thus earning him a high international reputation among experts that has continued up to this day.



Program

Symposium on Structural Durability
June 9–10, 2005 in Darmstadt, Germany

Thursday, June 9, 2005

9:00 **Opening**

Structural durability – A controversial research field of current interest

H. Hanselka (Fraunhofer Institute for Structural Durability and System Reliability LBF/Darmstadt University of Technology SzM/Germany)

9:10 Welcome address of the President of the Darmstadt University of Technology

J. D. Wörner (Darmstadt University of Technology/Germany)

9:15 **Opening Lecture**

Chairman: K. Feitzelmayer (Munich/Germany)

Darmstadt's basic contribution to structural durability – Historical review

V. Grubisic (Fraunhofer LBF, Darmstadt/Germany),
K. H. Kloos (Darmstadt University of Technology IfW/Germany),
T. Seeger (Darmstadt University of Technology IFSW/Germany)

10:00 **Awards for Outstanding Work on Structural Durability**

Instron-Award

HBM-Award

R. Bardenheier (Instron, Darmstadt/Germany),
K.-H. Haase (HBM, Darmstadt/Germany)

10:15 Coffee break

10:45– **Kurt Klöppel Lectures**

12:45 Chairman: E. Haibach (Wiesbaden/Germany),
B. Atzori (University of Padova/Italy)

10:45 Life cycle prediction of existing bridges

U. Peil (Technical University Carolo Wilhelmina at Brunswick/Germany)

11:15 Modelling and fatigue life assessment of complex fabricated structures

G. Marquis (Lappeenranta University of Technology/Finland)

- 11:45 Effects of residual stresses on the fatigue behaviour of welded steel structures

W. Fricke (Hamburg University of Technology/Germany)
- 12:15 Fatigue of welded hybrid-joints

R. Schliebner (IAMT mbH, Plauen/Germany),
M. Vormwald (Darmstadt University of Technology IFSW/Germany)
-
- 12:45 Lunch
-
- 14:00- **Ernst Gaßner Lectures**
- 15:30 Chairman: E. Macha (Technical University Opole/Poland),
C. M. Branco (IST Lisbon/Portugal)
- 14:00 Fatigue behaviour of welded structures of bus frames

G. Savaidis (Aristotle University of Thessaloniki/Greece)
- 14:30 Structural durability in automotive design

J.-J. Thomas (PSA Peugeot Citroën, Vélizy Villacoublay/France)
- 15:00 Local assessment concepts for the structural durability of complex components

C. M. Sonsino, G. Fischer (Fraunhofer LBF, Darmstadt/Germany)
-
- 15:30 Coffee break
-
- 16:00- **Ernst Gaßner Lectures** (continued)
- 17:30 Chairman: G. Glinka (University of Waterloo/USA),
M. Bacher-Höchst (R. Bosch GmbH, Stuttgart/Germany)
- 16:00 Standardized load-time histories – A contribution to durability issues under spectrum loading

P. Heuler (Audi AG, Ingolstadt/Germany),
T. Bruder, H. Klätschke (Fraunhofer LBF, Darmstadt/Germany)
- 16:30 Lifetime assessment of thin steel sheet structures

A. Esderts (University of Technology Clausthal IMAB/Germany)
- 17:00 Railway fatigue failures: An overview of a long standing problem

R. A. Smith (Imperial College London/UK)
-
- 17:45 Transportation to the hotels
-
- 18:45 Pick-off at the hotels, transportation to Lichtenberghaus
-
- 19:15 Reception and conference dinner
-
- 23:00 Transportation to the hotels
-

Friday, June 10, 2005

8:30- **August Thum Lectures**

11:00 Chairman: X.-R. Wu (Institute of Aeronautical Materials, Beijing/China),
H. Zenner (University of Technology Clausthal IMAB/Germany)

8:30 Crack opening displacement approach to assess
multiaxial low cycle fatigue

M. Sakane (Ritsumeikan University, Kusatsu-shi/Japan),
T. Itoh (Fukui University, Fukui/Japan),
D. Tchankov (Airbus, Hamburg/Germany)

9:00 Fatigue-life analysis of riveted-lap-joint panels
under ambient and salt-water conditions

J. C. Newman, Jr. (Mississippi State University, MS/USA),
R. S. Piascik (NASA Langley Research Center, Hampton, VA/USA)

9:30 Structural durability of magnesium alloys
and components

K. L. Kotte, S. Werdin (Dresden University of Technology IFKM/Germany),
M. Gugau, T. Trossmann (Darmstadt University of Technology IfW/Germany)

10:00 Fatigue behaviour of technical springs

B. Kaiser, C. Berger (Darmstadt University of Technology IfW/Germany)

10:30 Deformation and life assessment of high
temperature materials under creep-fatigue loading

A. Scholz, C. Berger (Darmstadt University of Technology IfW/Germany)

11:00 Coffee break

11:30- **New Horizons in Structural Durability**

13:00 Chairman: D. Socie (University of Illinois, Urbana/USA),
J. Dominguez (University of Sevilla/Spain)

11:30 Structural health monitoring for enhanced
understanding of the damaging process in structures

C. Boller (University of Sheffield/UK)

12:00 Design of a smart interface for vibration reduction
in complex structures

T. Melz, M. Matthias, M. Thomaier (Fraunhofer LBF, Darmstadt/Germany)

12:30 Future of structural durability in Darmstadt

C. Berger, H. Hanselka, M. Vormwald (Darmstadt University
of Technology/Germany)

13:00 **Closing remarks**

M. Vormwald (Darmstadt University of Technology IFSW/Germany)

13:05 Lunch

14:00- Visit of laboratories LBF, MPA/IfW, HBM,
16:30 all visits optional

Technical Visits

Friday, June 10, 2005, 14:00 till 16:30

Fraunhofer Institute for Structural Durability and System Reliability LBF, Bartningstraße 47, 64289 Darmstadt

“Innovative safety”: LBF focuses on structural durability since 65 years and plays a major role in many decisive developments in the industry. You may see the worldwide unique rail vehicle wheel test rig, the famous ZWARPs, adaptronic laboratory for reliability simulation and other testing facilities.

Hottinger Baldwin Messtechnik GmbH,

Im Tiefen See 45, 64293 Darmstadt

“Measurement with confidence”: HBM is a global market leader in weighing technologies, as well as test and measurement. HBM provides complete solutions – from sensor to software – for industrial and laboratory applications. The factory visit includes topics on strain gage and measurement technology.

State Materials Testing Institute Darmstadt/Institute for Materials Technology, Grafenstraße 2, 64283 Darmstadt

“Complex testing and simulation”: The visit will include the departments high temperature behaviour, strength of components as well as surface technology and corrosion.

Bus transfer from Orangerie

Get-together

Wednesday, June 8, 2005, 19:00 “Grohe Schänke”, Nieder-Ramstädter-Str. 3, 64283 Darmstadt, phone +49 (0)61 51/4 28 71 55, <http://www.grohe-gastro.de/pages/schaenke.html>

Thursday, June 9, 2005, 14:00 Conference Dinner, “Lichtenberghaus”, Dieburgerstr. 241, 64287 Darmstadt

Supporting Program

Thursday, June 9, 2005, 14:00 Guided tour to the Artists’ Colony at the Mathildenhöhe. A famous centre of the European Art Nouveau.

Friday, June 10, 2005, 9:00 Uhr Guided tour through Prinz-Georgs-Garden and Palace with porcelain collection of the Grand Duke of Hesse Ernst Ludwig.



Informations

Conference Location

Orangerie, Bessungerstr. 44, 64285 Darmstadt,

<http://www.orangerie-darmstadt.de/>

Conference office telephone: +49 (0)61 51/13 20 01

June 9th, 8:00 till 18:00, June 10th, 8:00 till 17:00

The Orangerie was built in 1719, in the baroque area, as a winter garden of the landgrave Ernst Ludwig. The famous building is surrounded by a nice French styled garden with citrus fruit trees. Nowadays, it hosts Meeting rooms.

Conference Language

The conference language is English. All presentations and discussions as well as the proceedings will be in English language.

Travel

Participants who stay in the recommended hotels will be picked up on Thursday, 9th of June: 8:30, Friday, 10th of June: 8:00. Before the conference dinner the participants will be brought by bus to their hotels. Bus transfer from the hotels to the conference dinner at "Lichtenberghaus", Dieburger Str. 241, June 9th and retour. Also to the technical visits on June 10th. Bus transfer possible: End of the symposium to railway station Darmstadt or airport Frankfurt.

Public transportation

Train 3, direction Lichtenbergschule, till stop "Orangerie". Public parking directly at the Orangerie, gateway via "Jahnstraße".

Information about Darmstadt

<http://www.darmstadt.de/>

<http://www.proregio-darmstadt.de/default.asp>

Registration Fee

380,00 €, Postgraduate: 160,00 €, Retiree: 78,00 €, Students: 50,00 €.

Members of the Advisory Board, Speakers and Organizers are free.

Registration and Payment Information

The closing date for registration is May 2, 2005. Acceptance after this date is dependent on the availability of places. Registration form see enclosure. Payments should be made by transfer order to:

Fraunhofer-Institut für Betriebsfestigkeit und Systemzuverlässigkeit LBF, Germany, Sparkasse Darmstadt, BLZ: 508 501 50, Account: 400 4639. Please add the code "**SoSDiD**" and name of delegate.

Cancellation

Refund of fee, less 20 % administration charge, may be applied for until May 2, 2005. After this date, fees can no longer be refunded. Receipt of a registration form is regarded as a firm booking and acceptance of the conditions stated above. If for any reason a delegate is unable to attend, payment of fees must still be honoured.

Accreditation and Certification

On request, participants will receive a confirmation of participation for accreditation and certification purposes.

Accommodation

Attendees will be responsible for making their own hotel reservations at the following hotel with code **"SoSDiD"**. To guarantee the special rates, please observe the deadline for reservation.

■ **ETAP Hotel Darmstadt**

<http://www.etaphotel.com>, Fax: +49 (0)61 51/3 97 37 25
25 Standard Rooms, Single Room: 37,00 €/night,
Double Room: 44,00 €/night, Breakfast: 5,00 €/person,
Deadline for reservation: May 8, 2005

■ **RAMADA – TREFF PAGE HOTEL Darmstadt**

<http://www.ramada-treff.de>, reservation@ramada-treff.de
Fax: +49 (0)61 51/38 51 00, Free call: 0 08 00/87 33 37 37
50 Standard Rooms, Single Room: 75,00 €/night, Breakfast:
12,00 €/person, Deadline for reservation: March 9, 2005

■ **Hotel Ibis Darmstadt**

<http://www.ibishotel.com>, Fax: +49 (0)61 51/3 97 01 23
15 Standard Rooms, Single Room: 62,00 €/night,
Breakfast: 9,00 €/person, Deadline for reservation: May 8, 2005

■ **MARITIM Rhein-Main Hotel Darmstadt**

<http://www.maritim.de>, Fax: +49 (0)61 51/30 31 11
50 Standard Rooms, Single Room: 105,00 €/night included
breakfast, Double Room: 130,00 €/night included breakfast,
Deadline for reservation: April 14, 2005

■ **Best Western Parkhaus-Hotel Darmstadt**

<http://www.bestwestern.de>, e-mail: pahoda@aol.com,
Fax +49 (0)61 51/29 39 08
25 Standard Rooms, Single Room: 80,00 €/night included
breakfast, Deadline for reservation: April 15, 2005

Please add to your reservation the code "SoSDiD".



By car: Take high-way A5 to exit "Darmstadt-Stadtmitte/Griesheim", then take country way B42 in the direction of Aschaffenburg/Stadtmitte Darmstadt. Turn right direction Heidelberg/B3. At the second traffic light turn left direction Höchst, after this, the second traffic light right into "Karlstraße", follow the white markers "Orangerie".

By train: Darmstadt-Hauptbahnhof (main station): at bay 6 take tramway 3 direction "Lichtenbergschule" till stop "Orangerie". At the left side of the street you may find the side-entrance to Orangerie-area for pedestrians only.

Travel time is about 15 minutes. Taxi from railway station is approximately 15 minutes.

By air: Frankfurt International Airport, train connection to "Darmstadt-Hauptbahnhof" (main station), or Terminal 1/2 bus AIR to Darmstadt "Darmstadt-Hauptbahnhof", change to tramway 3, as described above (approx. 60 minutes). Taxi from airport is approximately 40 minutes.

More informations: www.rmv.de

Registration form

Please return in envelope
or via fax: +49 (0)61 51/7 05-2 14



1st Symposium on Structural Durability in Darmstadt "Orangerie", June 9–10, 2005

Mrs. Ines Schäfer
Fraunhofer Institute for Structural Durability
and System Reliability LBF
P.O. Box 10 05 45
64205 Darmstadt
Germany

Attending

Name _____

Title _____

Company _____

Department _____

Address _____

Phone _____

Fax _____

E-mail _____

Date _____ Signature _____

I participate (please mark with a cross)	Yes	No
on Wednesday, June 8, get-together at "Grohe Schänke"	<input type="checkbox"/>	<input type="checkbox"/>
on Thursday, June 9, conference dinner at "Lichtenberg Haus"	<input type="checkbox"/>	<input type="checkbox"/>
I need transfer from hotel to symposium on Thursday morning	<input type="checkbox"/>	<input type="checkbox"/>
My partner is interested in a guided tour:		
Artists' Colony	<input type="checkbox"/>	
Prinz-Georgs-Palace	<input type="checkbox"/>	
On Friday, June 10, 14:30, I like to visit the laboratory of (please select only one)		
Fraunhofer LBF/SzM	<input type="checkbox"/>	
Hottinger Baldwin Messtechnik GmbH	<input type="checkbox"/>	
MPA/IfW	<input type="checkbox"/>	

Registration fee	<input type="checkbox"/>	380,00 Euro
Postgraduate	<input type="checkbox"/>	160,00 Euro
Retiree	<input type="checkbox"/>	78,00 Euro
Student	<input type="checkbox"/>	50,00 Euro
Member of Advisory board/Speaker	<input type="checkbox"/>	– free –

Payable to: Fraunhofer-Institut für Betriebsfestigkeit und Systemzuverlässigkeit LBF, Germany, Sparkasse Darmstadt BLZ 508 501 50, Account: 400 4639. Please add the code **"SoSDiD"** and name of delegate.

Hotel reservation should be made immediately directly with Code **"SoSDiD"**.

This form you will find also here: www.sosdid.com