

# EUROMECH Final Report

EUROPEAN MECHANICS SOCIETY

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Please send this report to the Secretary-General of EUROMECH, within one month after the Colloquium.

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EUROMECH Colloquium No. 385

Title: Inelastic analysis of structures under variable loads: theory and engineering applications

Dates and location: September 8-11, 1998, RWTH Aachen, Aachen, Germany

Chairman: Dieter WEICHERT

co-chairman: Giulio MAIER

Is there need of another Colloquium on the same or a related subject? Which year? Maybe 2004

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Full registration fee: 485 DM (German mark) / person

What other funding was obtained?

- Support for travel and accommodation costs of the scientists from developing countries from DFG (Deutsche Forschungsgemeinschaft) and RWTH Aachen

- Support from Robert Bosch GmbH

What were the participants offered?

Abstract booklet, information-set RWTH Aachen, handbag with material, lunch, coffee and snacks in the morning and the afternoon, banquet, social programme each evening

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Number of members of EUROMECH (reduced registration fee): 18

Number of non-members of EUROMECH (full registration fee): 39

Number of participants from each country:

Austria	-	Germany	11	Romania	-
Belgium	1	Great Britain	2	Russia	1
Byelorussia	-	Greece	2	Slovakia	-
Bosnia	-	Hungary	-	Slovenia	-
Bulgaria	-	Ireland	-	Spain	-
Croatia	-	Italy	9	Sweden	-
Czech Republic	-	Latvia	-	Switzerland	-
Denmark	-	Lithuania	-	Ukraine	3
Estonia	-	Netherlands	-	Yugoslavia	-
Finland	-	Norway	-	Others	11
France	9	Poland	8		
Georgia	-	Portugal	-	Total	57

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Please turn

### Scientific report:

The EUROMECH-Colloquium 385 entitled "Inelastic analysis of structures under variable loads: theory and engineering applications" took place from September 8 to 11, 1998 in Aachen. It has been attended by 57 scientists from 18 countries, 11 attendees came from noneuropean countries. The meeting can be regarded as the continuation of the scientific exchange on the analysis of inelastic structures under variable loads in the context of EUROMECH colloquia, with preceding conferences in Warsaw (1992) and Palermo (1983). In 41 lectures, the participants reported in Aachen on researches recently or currently conducted from theoretical, numerical and experimental points of view in this field of increasing technological interest. Applications in civil as well as in mechanical engineering were presented, related to the analysis of limit states of structures under variable repeated mechanical and/or thermal loading.

The organisers' scientific conclusions of the meeting are as follows. Significant progress has been achieved from the theoretical point of view in enriching existing theories and methods by more sophisticated and more realistic material models describing various inelastic effects which may lead to structural failure. Phenomena such as material damage, fatigue, non-associated flow rules, fluid saturation of porous media and slackening of structural joints have been taken into account by several contributors to the Colloquium in generalising limit analysis and shakedown theories and relevant «direct» (nonevolutive) analysis methods. On the computational side, the development and consolidation of methods could be observed which avoid through suitable simplifying assumptions, time-consuming optimisation procedures and provide rapidly practically essential information available not at all or only through cumbersome and costly procedures by usual commercial software. A trend towards software for shakedown analysis as a kind of post-processor attached to commercial software became apparent. This relates to the objective of many participants in the conference to foster the broader and industrial applications of methods of shakedown analysis.

Besides theoretically and computationally oriented contributions, a number of pertinent papers was presented on experimental investigations. Nevertheless, systematic and well documented experimental studies on the subject of shakedown are still rare and a need for more experimental data for the validation of theoretical and numerical methods was pointed out and motivated.

A follow-up colloquium on the subject in the near future is not needed but should be newly envisaged in 4-5 years from now.

It was proposed that the organisers either edit a proceeding volume of the Colloquium or try to have selected representative papers presented in this meeting gathered in a special issue of an internationally well established scientific journal in the field of solid and structural mechanics.

Attendees have agreed to mention the presentation at the Euromech Colloquium 385 if they will eventually publish elsewhere their contributions to the meeting.

Aachen and Milano, September 23, 1998

Dieter Weichert

Giulio Maier

# EUROMECH 385 - Programme

Forum 3 (FO3), Kármán-Auditorium

<b>Day 1:</b>	<b>September 8, 1998</b>	
8:00 - 8:15		<i>Registration</i>
8:15 - 8:20		<i>Opening of the Conference</i>
8:20 - 8:30		<i>Welcome by the Rector of the RWTH</i>
8:30 - 8:40		<i>Welcome by the Dean of the Faculty of Mechanical Engineering of the RWTH</i>
8:40 - 9:00		<i>Registration</i>
9:00	<i>Start of the scientific programme</i>	<b><i>Mathematical formulations, general computational methods</i></b>
9:00 - 9:30	M. Heitzer, M. Staat	Reliability analysis of elasto-plastic structures under variable loads
9:30 - 10:00	G. de Saxcé, J.B. Tritsch, M. Hjjaj	Shakedown of elastoplastic materials with non linear kinematical hardening rule by the bipotential approach
10:00 - 10:30		30 min. pause
10:30 - 11:00	E. Stein	Theory and computation of shakedown under fatigue fracture conditions
11:00 - 11:30	L. Bousshine, A. Chaaba, G. de Saxcé	A new approach of shakedown analysis for non standard elasto-plastic materials by the bipotential theory
11:30 - 12:00	Pham D.C.	Dynamic cycle collapse of some elastic plastic structures
12:00 - 14:00		120 min. pause

14:00 - 14:30	Y. Liu, Z. Cen, Y. Xu	Subdomain bounding technique for large scale shakedown analysis
14:30 - 15:00	N. Zouain, J.L. Silveira	Variational principles for shakedown analysis
15:00 - 15:30	H. Stumpf, B. Schieck	On the incremental shakedown analysis in finite elastoplasticity
15:30 - 15:45		15 min. pause
15:45 - 16:15	A.R.S. Ponter, M. Engelhardt	A computational techniques for shakedown limits and related problems
16:15 - 16:45	R. Bairrao, J. Duque, M. Chrzanowski, P. Latus, S. Oliveira	Numerical and experimental RC beams behaviour analysis under variable loading - damage accumulation
<b>Day 2:</b>	<b>September 9, 1998</b>	<b><i>Advanced material models, structural analysis and design</i></b>
8:30 - 9:00	G.J. Dvorak, D.C. Lagoudas, C.-M. Huang	Shakedown as a fatigue damage mechanism in metal matrix composite laminates
9:00 - 9:30	A.A. Liolios	A numerical approach to unilateral contact dynamic problem of soil-pile interaction under second-order effects
9:30 - 10:00	A. Hachemi, D. Weichert	Theoretical and numerical shakedown loads for damaged structures
10:00 - 10:30		30 min. pause
10:30 - 11:00	G. Cocchetti, G. Maier	Some contributions to a shakedown theory in poroplasticity
11:00 - 11:30	M. Cuomo	Cyclic loading of elasto-plastic-damaging materials
11:30 - 12:00	B. Druyanov, I. Roman	On the shakedown of anisotropically damaged elastic plastic bodies

12:00 - 13:45		105 min. pause
13:45 - 14:15	M.S. Kuczma, A. Gawecki	Slackened-viscoelastic-plastic skeletal structures under variable loads
14:15 - 14:45	H.S. Yu	Shakedown analysis of pavements using discontinuous stress fields
14:45 - 15:15	M. Boulbibane, I.F. Collins	Application of the kinematic shakedown theorem to pavements design
15:15 - 15:45	B. Nayroles, C. Ossadzow	Complementary displacement method and plate shake-down
15:45 - 16:00		15 min. pause
16:00 - 16:30	K. Wiechmann, F.-J. Barthold, E. Stein	Variational design sensitivity analysis of linear kinematic hardening structures under shakedown conditions
16:30 - 17:00	K.V. Spiliopoulos	On the numerical implementation of simplified methods of inelastic analysis of cyclically loaded structures
17:00 - 17:30	A. Siemaszko, G. Bielawski, J. Zwolinski	CYCLONE - a system for structural adaptation and limit analysis
<b>Day 3:</b>	<b>September 10, 1998</b>	<b><i>Analysis of structures in civil and mechanical engineering</i></b>
8:30 -9:00	Yan A.M., Nguyen D.H.	A modified Koiter's shakedown formulation
9:00 - 9:30	H. Altenbach, D. Breslavsky, O. Morachkovsky, K. Naumenko	Simulation of cyclic creep-damage behaviour of thin-walled structures using asymptotic expansions
9:30 - 10:00	M. Gizejowski, J. Karczewski, E. Postek	Computational model of the frame with semi-rigid nodes

		30 min. pause
	J. Zarka, J. Huang, P. Navidi	Reliability of inelastic structures subjected to general loadings
	H. Hübel	Trial application of Zarka's method under cyclic loading
	C. di Prisco, B. Fornari, R. Nova, S. Pedretti	A constitutive model for cyclically loaded shallow foundations
		105 min. pause
	A. Sawicki	Modelling the rheological properties of reinforced soil
	W. Dornowski, P. Perzyna	Numerical simulations of thermo-viscoplastic flow processes under cyclic dynamic loadings
	S.V. Petinov	Modeling of fatigue behavior of an aluminium alloy for application in fatigue assessment of structures
	S. Cangiano, G.A. Plizzari	Fatigue behaviour of fibre reinforced concrete: comparison between material and structural response
		15 min. pause
	R. Zinno, D. Bruno	Damage analysis of layered composite plates under cyclic loading
<b>Day 4:</b>	<b>September 11, 1998</b>	<b><i>Experimental and numerical studies, material modeling</i></b>
8:30 - 9:00	P. Grundy, N.K. Milani, K. Dale	Incremental collapse of tubular structures
9:00 - 9:30	S. Imatani, T. Inoue	Stress analysis of quenching process following draw forming
9:30 - 10:00	M. A. Hamadouche, D. Weichert	Shakedown of pavements and soil structures under dynamic loads

10:00 - 10:30		30 min. pause
10:30 - 11:00	A. Glema, T. Lodygowski, P. Perzyna	Localization of plastic deformations as a result of wave interaction
11:00 - 11:30	G. Inglebert, T. Hassine, M. Pons	Shakedown and damage analysis in the Ariane V program
11:30 - 12:00	A. Zolochovsky	Creep damage model under variable loads for materials with different behavior in tension and compression
12:00 - 13:45		105 min. pause
13:45 - 14:15	A. Callerio, E. Papa, A. Nappi	Analysis of masonry structures subject to variable loads: a numerical approach based on damage mechanics
14:15 - 14:45	P. Grundy, G. Taplin	Incremental collapse of structures with slip
14:45 - 15:15	S.M. Abdall, M.A.E. Mohamed, Y.T. Shawky, L.Z. Youssef	Inelastic response of infilled frames subjected to reversable loads