The Department of Structural Engineering and Building Technology at Aalto University School of Science and Technology is organising an intensive postgraduate course on damping and control of flexible structures. The course is a part of the program of the National Graduate School in Engineering Mechanics.

The course will be lectured by professor Steen Krenk from the Technical University of Denmark. The lectures will be given at the Department of Structural Engineering and Building Technology, address: Rakentajanaukio 4A, Espoo.

All the inquiries can be directed to Reijo Kouhia tel: +358 (0)9 47023755, or email: Reijo.Kouhia@tkk.fi. Registrations for the course will be taken care by the secretary Elsa Nissinen-Narbro tel: +358 (0)9 47023701, or fax: +358 (0)9 47023826, or email: Elsa.Nissinen-Narbro@tkk.fi.

If accommodation services are needed, please, ask for the information from the secretary.

Course program

Lectures at lecture halls R9 (third floor, Wednesday) and R3 (second floor, Thursday, Friday).
Wednesday: 9.15—12.00 and 13.15—14.00,
Thursday: 13.15—17.00,
Friday: 9.15—12.00 and 13.15—14.00.

Content

1 Structural dynamics - background
a) Characteristics of the single degree-of-freedom-system.
b) Modal analysis via the generalized eigenvalue problem.
c) Representation of structural damping.
d) Random loading and response.

2 Damping of simple structures or structural elements
a) Complex frequencies and modes.
b) Taut cable and cable with sag.
c) Beam with dampers.
d) Effect of damper characteristics.

3 Dampers on discretized structural models
a) Introduction of a local damper.
b) The root locus diagram.
c) An approximate two component format.

4 Resonant vibration absorbers
a) Tuned mass absorber - principle and calibration.
b) A 'real life' pedestrian bridge example.
c) Random response and representation of pedestrian loads.

5 Resonant control of structures
a) Principles of 'collocated resonant response'.
b) Some examples of resonant control.

Aalto University School of Science and Technology
Department of Structural Engineering and Building Technology

Graduate school of Engineering Mechanics
Ph.D. course on

Damping and Control of Flexible Structures

2nd – 4th June, 2010

A course given by

Steen Krenk

Department of Mechanical Engineering
Technical University of Denmark

Course content

The increased use of slender and flexible structures has introduced an increased focus on structural damping and control. In its simplest form the damping is introduced via passive devices like viscous or friction dampers. These dampers dissipate energy, when the two ends of the device experience relative motion, and thus their efficient use depends critically on a balance between sufficient motion to activate the damping and sufficient damping to dissipate energy. A general approach, initially developed for damping of cables, will be presented.

Most structural damping problems are associated with particular vibration modes and take place at the corresponding modal frequency. Efficient damping can often be obtained by introducing an appropriate resonant mass, tuned to the modal frequency – the 'tuned mass damper'. The basic principle will be discussed and a novel calibration method, based on frequency analysis of the combined structure-damper system, will be presented.

In recent years much research effort has been invested in 'smart structures' – structures that react in a desirable way. Typically this relies on some kind of electronic control methodology. It is demonstrated, how the basic idea of the tuned mass damper can be generalized to a 'resonant controller' for structures. In such a device the resonant force is produced by a controller that can account for changing frequencies, and the influence of background motion from other modes.

Course Material

S. Krenk: *Dampers on Flexible Structures*, Semi-Active Vibration Suppression – The Best from Active and Passive Technologies, CISM, Udine, October 1-5, 2007. pp. 61.

S. Krenk, Vibrations of a taut cable with an external damper, *Journal of Applied Mechanics*, **67**, 772-776, 2000.

J.A. Main & S. Krenk, Efficiency and tuning of viscous dampers on discrete systems, *Journal of Sound and Vibration*, **286**, 97-122, 2005.

S. Krenk, Frequency analysis of the tuned mass damper, *Journal of Applied Mechanics*, **72**, 936-942, 2005.

S. Krenk & J. Høgsberg, Tuned mass absorbers on damped structures under random load, *Probabilistic Engineering Mechanics*, **23**, 408-415, 2008.

S. Krenk & J. Høgsberg, Optimal resonant control of flexible structures, *Journal of Sound and Vibration*, **323**, 530-554, 2009.

Participants

The participants are assumed to have a back-ground in continuum and structural mechanics.

Requirements and credits (ECTS)

Attending lectures and successful completion of home exercises will give 5 credit points.

Further information

The lectures will be given in the Department of Structural Engineering and Building Technology, Rakentajanaukio 4A, Espoo. (Number 4 in the map below).
Up to date information available at:
http://buildtech.tkk.fi/fi/ajankohtaista/uutiset/

Arriving to Otaniemi

Buses from the centre of Helsinki
102, 102T,103 (Line T via Lauttasaari)
194,195 via Munkkiniemi
From the centre of Tapiola
2,4,4T,10,15,52,194,195,505,510,512,550

Bus 103 stops at the library (24) on Otaniementie and both 194 and 195 stops opposite the library on Vuorimiehentie. Bus 102 stops on Otaniementie and Otakaari.
Aikataulut/Timetables **http://www.ytv.fi/**