The analytical approach has two steps, first determining analytically the necessary optimality criterion, in this case related to compliance. The compliance is the work of external dead loads and may be evaluated from internal elastic energies. Using beam theory under the assumption of linear elasticity we have that the compliance is twice the stress (complementary) elastic energy. From this follows, using a direct approach with zero normal force and zero torsional moment, analytically the general optimality criterion.

The second analytical step is to determine an explicit analytical solution to the optimality criterion and this step is limited to statically determinate beams as the optimality criterion can then be written independently of the design. A number of problems are chosen so that a full analytical approach is reasonable.

The present study concentrates on the area distribution along the beam axis and is limited to cases that make an analytical study possible. Numerical models give the possibility for detailed studies and without the analytical complexities for statically indeterminate beams. For such extended formulations it is important to justify the resulting analysis and design, say relative to problems where some analytical knowledge is available.

Two aspects prevent explicit analytically optimal designs, but implicit solutions may then be obtained by a few iterations. The first aspect is related to size constraints, due to the missing knowledge about the regions where these size constraints are active. The second aspect concerns statically indetermined cases, where the shear force and moment distribution is depending on the actual design. Often both aspects must be taken into account, which can be done simultaneously. With side constraints the given volume is substituted by the iteratively determined "active" volume of free design. With statically indetermined boundary conditions, we can also use optimality criteria, then with iterations on the shear force distribution and the moment distribution before the optimal design is determined.

1070 An optimization method for building frames considering the discontinuity of the structural property coefficient Ds

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Two relaxation formulations for the minimum weight design problem of building frames considering the discrete constraints of the plastic limit load factor are presented in this paper. The required plastic limit load factor is determined by a discrete variable called "structural property coefficient, Ds" in the Building Standard Law of Japan. The minimum weight design problem considering the discrete constraints of the plastic limit load factor becomes a mixed integer programming problem, which can be solved by a branch and bound approach. The structural property coefficient Ds is determined by the types of frame members based on their width-thickness ratio. The structural property coefficient Ds of each story can be represented by three 0-1 variables for the types (A, B, C) of each story. A linear relaxation and a positive semi-definite (SDP) relaxation of these 0-1 variables are presented to compose the relaxation formulations for a branch and bound approach. Although a SDP relaxation is often more effective than a linear relaxation for a combinational optimization problem, as the positive semi-definite constraint is needed for a SDP relaxation, the calculation amount of a SDP relaxation is larger than that of a linear relaxation. The efficiency and effectiveness of these two relaxation formulations are investigated with a numerical example. And the effectiveness of relaxation for the minimum weight design problem considering the discrete constraints of the plastic limit load factor is also discussed.

1078 Optimization of passive vibration isolators mechanical characteristics

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The contribution of optimization has been essential in the more recent developments in design of new mechanical structures and materials. The objective of this contribution is to extend the models of material and structural optimization to the design of passive vibration isolators.

As a first step a computational tool to identify the optimal visco-elastic characteristics (stiffness and damping) of a non linear one-dimensional isolator was developed. The cost functional involves the minimization of a weighted average of the maximum transient and steady state response amplitudes for set of predefined dynamic loads and time intervals. The optimal isolator behavior to the given set of loads is obtained by generic probabilistic meta-algorithm, simulated annealing.

The solutions obtained ("global optimum") are discussed and its dependence on the leading parameters of the simulated annealing procedure, like neighborhood definition and annealing schedule, is also studied and analyzed.

The results obtained can facilitate the design of elastomeric materials with improved behavior in terms of dynamic stiffness for passive vibration control. Future research will be directed to the design of cellular and composite viscoelastic materials with improved behavior identified by the procedure presented in this contribution. This application will have a direct and immediate impact on product design and development, especially in the design of new mechanical components such as engine mounts and new suspension systems.

1086 Discrete optimum design of cable-stayed bridges

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The optimization of cable-stayed bridges can be stated as that of the minimization of structural cost or volume and the maximum stresses and displacements throughout the structure. Additional objectives are aimed at deflections or displacements and to guarantee that the design variables are at least specified minimum values. The work started with the shape and sizing optimization by using a 2D finite-element model for the analysis. An equivalent multi-criteria approach was used to solve the continuous design problem turning the original problem into the sequential minimization of unconstrained convex scalar functions from which a Pareto optimum is obtained. It included a direct analytic sensitivity analysis module, which provides the structural behavior responses to changes in the design variables. The problem was extended to three-dimensional analysis and the consideration of