

Cross-Sectional Area Constraint: $(w_1 + w_2)(H_1 + H_2 + 1)/2 = 150$ or

$$h_1 = (w_1 + w_2)(H_1 + H_2 + 1)/2 - 150 = 0;$$

Excavated Material Constraint: $(w_1 + w)(H_1/2) = (2)(w_2 + 2)(H_2 + 1)/2$ or

$$h_2 = (w_1 + w)(H_1/2) - (w_2 + 2)(H_2 + 1) = 0$$

The design variables are not independent; they are related as follows:

$$\tan \theta = \frac{H_1}{(w - w_1)/2} = \frac{H_2 + 1}{(w_2 - 2)/2} = \frac{H_1 + H_2 + 1}{(w_2 - w_1)/2}$$

So we get two more constraints from these relationships, as

$$h_3 = \frac{H_1}{w - w_1} - \frac{H_2 + 1}{w_2 - 2} = 0;$$

$$h_4 = \frac{H_1}{w - w_1} - \frac{H_1 + H_2 + 1}{w_2 - w_1} = 0$$

All the design variables must also be nonnegative:

$$-w \leq 0; \quad -w_1 \leq 0; \quad -w_2 \leq 0; \quad -w_3 \leq 0; \quad -H_1 \leq 0; \quad -H_2 \leq 0$$

Formulation 2:

Step 1: Problem Statement

Shown above

Step 2: Data and Information Collection

Shown above

Step 3: Definition of Design Variables

w_1 , H_1 , H_2 (m), and s (unitless) are chosen as design variables which are defined below in relation to Figure E2.22:

$$s = \tan \theta$$

$$w = w_1 + \frac{2H_1}{s}$$

$$w_2 = w_1 + \frac{2(H_1 + H_2 + 1)}{s}$$

$$w_2 = 2 + \frac{2(H_2 + 1)}{s}$$

Step 4: Optimization Criterion

Optimization criterion is to minimize the volume of excavation, and the cost function is defined as:

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Dan M. Frangopol



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Optimal Design and Control Jeff Borggaard, John Burkhardt, Max Gunzburger, Janet Peterson, 2012-12-06 This volume is the proceedings of the Workshop on Optimal Design and Control that was held in Blacksburg Virginia April 8 9 1994 The workshop was sponsored by the Air Force Office of Scientific Research through the Air Force Center for Optimal Design and Control CODAC at Virginia Tech The workshop was a gathering of engineers and mathematicians actively involved in innovative research in control and optimization with emphasis placed on problems governed by partial differential equations The interdisciplinary nature of the workshop and the wide range of subdisciplines represented by the participants enabled an exchange of valuable information and also led to significant discussions about multidisciplinary optimization issues One of the goals of the workshop was to include laboratory industrial and academic researchers so that analyses algorithms implementations and applications could all be well represented in the talks this interdisciplinary nature is reflected in these proceedings An overriding impression that can be gleaned from the papers in this volume is the complexity of problems addressed by not only those authors engaged in applications but also by those engaged in algorithmic development and even mathematical analyses Thus in many instances systematic approaches using fully nonlinear constraint equations are routinely used to solve control and optimization problems in some cases replacing ad hoc or empirically based procedures

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Structural Sensitivity Analysis and Optimization 2 K. K. Choi, Nam-Ho Kim, 2006-12-22 Extensive numerical methods for computing design sensitivity are included in the text for practical application and software development The numerical method allows integration of CAD FEA DSA software tools so that design optimization can be carried out using CAD geometric models instead of FEA models This capability allows integration of CAD CAE CAM so that optimized designs can be manufactured effectively

Advances in Metaheuristic Algorithms for Optimal Design of Structures A. Kaveh, 2016-11-09 This book presents efficient metaheuristic algorithms for optimal design of structures Many of these algorithms are developed by the author and his colleagues consisting of Democratic Particle Swarm Optimization Charged System Search Magnetic Charged System Search Field of Forces Optimization Dolphin Echolocation Optimization Colliding Bodies Optimization Ray Optimization These are presented together with algorithms which were developed by other authors and have been successfully applied to various optimization problems These consist of Particle Swarm Optimization Big Bang Big Crunch Algorithm Cuckoo Search Optimization Imperialist Competitive Algorithm and Chaos Embedded Metaheuristic Algorithms Finally a multi objective optimization method is presented to solve large scale structural problems based on the Charged System Search algorithm The concepts and algorithms presented in this book are not only applicable to optimization of skeletal structures and finite element models but can equally be utilized for optimal design of other systems such as hydraulic and electrical networks In the second edition seven new chapters are added consisting of the new developments in the field of optimization These chapters consist of the Enhanced Colliding Bodies Optimization Global Sensitivity Analysis Tug of War Optimization Water Evaporation Optimization Vibrating Particle System Optimization and Cyclical Parthenogenesis Optimization algorithms A chapter is also devoted to optimal design of large scale structures

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