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Optimization of Steel Structures for Fire Resistance Using PSO

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Steel structures have been used in industrial and residential buildings, because it offers a wide range of advantages. However these structures, when unprotected, behave poorly in fire situation. The high thermal conductivity of steel, together with the deterioration of its mechanical properties as a function of temperature, can lead to large deformations of structural elements and the premature failure of the buildings. The steel can be protected by materials such as mineral fibres, gypsum boards, concrete, intumescent paints and water-filled structures. In this study the optimal fire design of a steel frame structure is investigated. Using a relatively simple frame model it is shown how to apply the optimum design system for the case of fire resistance of a welded steel structure. Welded box columns and rolled I-section beams are designed for minimum weight and cost. Overall and local buckling constraints are considered.
In the first design phase the structural volume is used as an objective function. A refined objective function can be the material cost. A final objective function will be the total cost including the steel mass, the fire protection technique employed and the erection costs. A relatively new and promising optimization technique is introduced, the particle swarm optimization (PSO). In this evolutionary technique the social behaviour of birds is mimicked. The technique is modified in order to be efficient in technical applications. It calculates discrete optima, uses dynamic inertia reduction and craziness at some particles. PSO is also built into a program system to solve multiobjective optimization problems as well.

Modelling of Filling and Discharge of Granular Materials in Hoppers by Discrete Element Method: Optimisation of Some Flow Parameters

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The issues of granular material filling and discharge in hoppers are always associated with evolution of pressures on hopper walls, particle segregation, effect of vibration and other numerous important factors and effects, which are predefined by material flow parameters. Using of discrete concept and numerical discrete element method (DEM) technique allows to take into account particulate nature of granular material, inspires a better understanding of the fundamentals of granular flow and helps to solve technological problems.
The DEM is based on the Lagrangian approach, meaning that particles of granular material are treated as frictional visco-elastic bodies, while dynamic parameters (position, velocity, orientation, etc.) of each particle are tracked during the simulation. Dynamic flow of granular material is defined by the inter-particle, particle-wall and gravity forces and described numerically by a system of classical equations of the Newton's laws.
In this paper, the DEM model is applied for simulations of filling and discharge of granular materials in a wedge shape hopper and serves the base for optimization of flow parameters. Validation of presented DEM model was obtained by examination of the wall pressure and comparison with classical macroscopic pressure prediction. Actually, filling problem is considered as numerical generation of initial conditions for discharge flow.
Multi-objective approach was used for minimization of the discharge time and the discharge flow rate. The material discharge mass, the material–wall friction and the shape of the hopper are considered as design variables. Variation of optimality criteria and Pareto set is demonstrated by numerical results.

Optimization of the Operation of Isolated Industrial Diesel Stations

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The conventional alternative to off-grid electrification is industrial Diesel gensets. Diesel systems are reliable; nevertheless, generation costs are usually high due to fuel and operational and maintenance costs. To a certain extent, such costs depend upon the generator's size and operation dispatch. Despite the large number of works dealing with optimization of on-grid-connected systems, few works are devoted to the optimization of the operation of isolated industrial Diesel stations. The purpose of this work is to minimize off-grid Diesel generation costs by best choosing the size and the dispatch of the generators. The mathematical formulation of the optimization problem takes into account: size-dependent full-and part-load fuel consumption; size dependent investment costs; size- and dispatch-dependent operational and maintenance costs. It is assumed that daily hourly demand is known. The objective function is the annual sum of the fuel, investment and operational and maintenance costs on an hourly basis. The decision variables are the hourly generator's load factors. In the optimization routine, the number of generators is prescribed.