

Design and construction of long-span single-layer dome structures by direct analysis

a b b a
Y P Liu, S J Pan, Simon W K Leung and S L Chan

a *Department of Civil & Environmental Engineering, The Hong Kong Polytechnic University, Hong Kong, People's Republic of China*

b *Building Construction, China State Construction Engineering (Hong Kong) Limited, Hong Kong People's Republic of China*

Abstract

Long-span roofs are widely used worldwide as they provide large internal spaces without obstructions like columns. In designing long-span roofs, the traditional design method faces many difficulties, such as uncertainty in buckling effective length. The advanced second-order direct analysis (SODA) method for design shows and has many advantages for structural safety and cost saving. In this paper, the SODA considering P- and P- δ effects as well as initial imperfections is proposed for designing of long-span roofs and the assumption of effective length is no longer required. The application of this concept of SODA to the design of practical structures appears to be new and unique, especially on the aspects of design at the construction stages. Key considerations for the construction of long-span structures by SODA are first reported. The planning of the lifting procedure, temporary support system (TSS) and off-loading sequences for load transfer from a TSS to permanent structure is guided by SODA such that an economic design and safe construction can be achieved. A constructed long-span single-layer roof structure in Macau is used to demonstrate the validity, practicality, accuracy and reliability of the proposed method and is taken as an example of successful joint work for advanced design by academicians and engineers in practice.

Keywords

Second-order direct analysis;
Construction sequence;
Long-span structures;
Dome structures;
Off-loading analysis