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THANAPON BUAMONGKOL : OPTIMUM DESIGN OF LONG SPAN STEEL ROOF TRUSSES WITH NONLINEAR GEOMETRIC BEHAVIOUR AND IN-PLANE STABILITY CONSTRAINT. THESIS ADVISOR : ASST.PROF.ROENGDEJA RAJATABHOTHI, 87 pp. ISBN 974-03-0908-9.

This paper presents a method of design optimisation of steel roof trusses with nonlinear geometric and in-plane stability considerations. The strain energy density which is an index showing the contribution of each member to the total displacement can be evaluated. The material should be added to members with high strain energy density and removed from members with low strain energy density. Theoretically, the optimum design is obtained when all members have the same strain energy density. By using this method, however, the solution is not guaranteed to be absolutely optimum because not all variables were included in the optimised function such as residual stress, imperfection, reliability.

As the solution from the design optimisation tends to reduce the amount of required material, the role of structural stability becomes more important. The solution from in-plane optimisation must be checked for out-of-plane stability and the structure braced accordingly in order to maintain the validity of the in-plane solution.

Examples include a highly nonlinear shallow truss and plane roof trusses with span length ranging from 30 m to 80 m. One of these is a 64-m roof truss for the existing Chiang Mai University convention hall. By design optimisation, the required amount of steel is 30.9 tons excluding close bracing in the middle zone, as against 32.9 tons used in the actual truss. However, by estimated comparison, the actual truss including bracing turned out to be 4 percent lighter than that given by the optimised solution.