

A Comprehensive Review on Structural Properties and Erection Benefits of Large Span Stressed-Arch Steel Truss Industrial Buildings

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Abstract : Design and build of large clear span structures have always been demanding in the construction industry targeting industrial and commercial buildings around the world. The function of these spectacular structures encompasses distinguished types of building such as aircraft and airship hangars, warehouses, bulk storage buildings, sports and recreation facilities. From an engineering point of view, there are various types of steel structure systems that are often adopted in large-span buildings like conventional trusses, space frames and cable-supported roofs. However, this paper intends to investigate and review an innovative light, economic and quickly erected large span steel structure renowned as "Stressed-Arch," which has several advantages over the other common types of structures. This patented system integrates the use of cold-formed hollow section steel material with high-strength pre-stressing strands and concrete grout to establish an arch shape truss frame anywhere there is a requirement to construct a cost-effective column-free space for spans within the range of 60m to 180m. In this study and firstly, the main structural properties of the stressed-arch system and its components are discussed technically. These features include nonlinear behavior of truss chords during stress-erection, the effect of erection method on member's compressive strength, the rigidity of pre-stressed trusses to overcome strict deflection criteria for cases with roof suspended cranes or specialized front doors and more importantly, the prominent lightness of steel structure. Then, the effects of utilizing pre-stressing strands to safeguard a smooth process of installation of main steel members and roof components and cladding are investigated. In conclusion, it is shown that the Stressed-Arch system not only provides an optimized light steel structure up to 30% lighter than its conventional competitors but also streamlines the process of building erection and minimizes the construction time while preventing the risks of working at height.

Keywords : large span structure, pre-stressed steel truss, stressed-arch building, stress-erection, steel structure

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