Bridge Structures 7 (2011) 53–54
DOI:10.3233/BRS-2011-027
IOS Press

Editorial

Today the methods for mass energy storage are the pumped hydro-electric and Compressed Air Energy Storage (CAES). Whilst the former requires two reservoirs at different levels, the CAES requires only space for storing compressed air. Underground caverns have been used for CAES in power plants in Huntorf of Germany, 1978 and McIntosh of Alabama, USA, 1991. The CAES of a power plant is to regulate the mismatching supply and demand of the grid power, so that the electricity would not be wasted when it is not needed. It is equally important to save energy as to regenerate it. To store the equivalent energy of a power plant, a sizable container is needed. Suitable underground caverns are difficult to find. Bridge structures are plentiful in many cities and their body space is voluminous. Steel pipes are the most effective structural element in storing compressed air. It can perform as a beam to carry loads. The new bridge form is to replace the girders with steel pipes that can carry loads and compressed air. The pipes provide the space for storing mass of unwanted electricity and the intermittent power output from regenerated energy sources such as wind and solar. The stored compressed air can be released to regenerate power according to the demands. The bridge is designed to operate in three levels of safety measures. With proper implementation, it will substantially reduce the energy wastage in the grid and the carbon footprint of the city, and create new industry and new jobs. In the lead paper in this combined issue of the journal, "An innovative energy storage bridge", Wong describes the new bridge form and its applications. Tri-County Metropolitan Transportation District (TriMet) of Oregon is extending transit service from Portland State University to Milwaukie. As part of this extension, TriMet is constructing a cable-stayed bridge across the Willamette River. When completed, the Portland Milwaukie Light Rail (PMLR) Bridge will be the first transit-only cable-stayed bridge built in the United States and will include capacity for light rail, buses, bicycles, pedestrians, and streetcars in the future. The crossing features a 524 m (1,720 ft.) bridge with a 238 m (780 ft.) main span. In "Portland Milwaukie Light Rail Bridge: First transit-only cable-stayed bridge offers unique capacity for shared use", Jones et al. provide details of the analysis performed to ensure pedestrian comfort during dynamic excitation of the bridge from transit vehicles. A synchronized lateral excitation investigation further ensured pedestrian comfort under the condition of full pedestrian access across the entire bridge during special occasions when the bridge will be closed to transit vehicles. In "Lateral loads applied by pedestrians at normal walking velocities", Archbold and Mullarney present on the theme of horizontal loading from pedestrians and imposed excessive vibration of structures subjected to this form of excitation. The authors have carried out over 100 walking trials on 27 healthy adult participants walking at normal velocities on a rigid walkway mounted with a force plate. Additionally, the lateral forces recorded during these tests are presented and analyzed. A simplistic force function, based on the fundamental frequency of the applied excitation force, which may approximate the actual load applied by individual pedestrians is proposed. Further, this function is improved by consideration of the lateral force contribution at higher order harmonics of the fundamental frequency and relevant dynamic load factors and phase angles associated with the individual force functions are derived and optimized. New wire rope materials and designs provide increased strengths and improved mechanical properties allowing designers and engineers to take full advantage of the material strengths available. These developments involve high tenacity synthetic materials protected by high strength corrosion resistant carbon steel wires. This provides a hybrid wire rope with a high strength to weight ratio, low torque, and excellent operating characteristics that can outperform any wire rope related product currently available on the market. This results in longer field service, increased corrosion protection, less maintenance, and smaller diameter wire ropes in service applications. All of these characteristics are beneficial to the owner/operator of the movable structure. In "The Advancement of Wire Rope in Movable Bridges", Klein discusses the mechanical properties and benefits of improved wire rope constructions verses those currently specified for use in the AASHTO Standard Specification for Movable Bridges and the AREMA Manual for Railway Engineering. The use of new technology in Vertical Lift Bridge applications is non-existent in the United States. The European community utilizes wire rope products as described above to transform movable structures into iconic bridges. AASHTO and AREMA have made recent progress in adopting new wire rope standards. Bridge decks are subject to severe loading conditions as they are loaded by large numbers of concentrated axles. In the case of orthotropic bridge decks, it is known that the combination of these loading conditions and the quantity of required welds may not allow for a durable and still cost-effective solution with this type of deck in the future. Nevertheless, still progress is made in the analysis and specifications, but the efforts are large and the profits are moderate. Consequently, a search for alternatives for the future is valuable, and probably even necessary. De Corte presents current state of the art regarding alternative solutions for orthotropic decks in "A review of alternatives for orthotropic bridge deck panels." These include fiber reinforced composites, and steel–concrete sandwich solution, developed by the author. In the latter alternative, a cellular concrete grid is injected between two steel plates, resulting in a non-welded and more isotropic rather than orthotropic deck behavior. For this purpose high strength self compacting concrete is to be used. Challenges in the design and manufacture are in this case, the SCC mix, the steel to concrete adhesion, and the shear capacity, rather than the fatigue design. Theoretical investigations as well as experimental results are presented. The results indicate that, although some parameters are still to be optimized, alternative solutions for orthotropic bridge deck panels will be available. When opened in 1981, the Humber Bridge became the world's longest span at 1410 m, a record it held for 17 years. Internal cable inspections of the two older major UK suspension bridges from 2004 to 2006 revealed unexpected levels of corrosion and broken wires. Following this discovery the Humber Bridge Board commissioned the development of a pro-active maintenance strategy which led to an internal inspection of the cables in 2009. Although only a few broken wires were found, there was extensive corrosion present which confirmed the need to minimize future deterioration and monitor the cable condition. In "Humber Bridge Main Cable Dehumidification and Acoustic Monitoring – The World's Largest Retrofitted Systems", Cocksedge et al. present details of the cable dehumidification and acoustic systems. At different stages during the construction of steel, I-girder bridges having severely skewed abutments, differential deflections between adjacent and interconnected girders cause rotations and deflections out of plane. These deformations are more pronounced during deck placement when appreciable additional dead load is added to the bridge and the girders are non-composite. As a result, girder webs can end up out of plumb at the completion of construction, especially at the supports. Although it is commonly desired by bridge designers and contractors to alleviate this out of plumbness via different erection and detailing strategies, out of plumbness effects on skewed bridge response at the completion of construction are not completely understood. In "Web plumb influence on skewed I-girder, steel bridges during construction" Sharafbayani et al. employ finite element analysis to study effects that different detailing methods have on girder stresses, vertical and lateral deformations, and cross-frame forces for single-span bridges with varying skew angles.

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