Indian Association of Structural Engineers

Cordially invites you to

Technical Lecture on

CABLE SUSPENDED STRUCTURES

by

Dr. Prem Krishna

Former Professor, IIT Roorkee

at

Lecture Room, Consultancy Development Centre

2nd Floor, Core 4B, India Habitat Centre

Lodhi Road, New Delhi 110 003

on

Thursday, 22nd February 2018

Starting at 05:00 pm

Please confirm your participation

S K DHAWAN, Chairman, Monthly Lecture & Technical Discussion

Email: iastructe@gmail.com, Tel: (011) 45794829

The event is supported by UltraTech Cement Ltd

(Light refreshment will be served)

ABOUT THE FACULTY

Born in March 1938, Dr. Prem Krishna obtained his early degrees from the University of Roorkee - BE(Civil) in 1959 and ME(Structures) in 1961.He obtained his Doctorate from Imperial College, London in 1964 in the subject of Funicular Suspension Systems.

Dr.Prem Krishna joined the faculty of Civil Engineering at the University of Roorkee in 1965 and retired fromthere in 1998. He however maintained contact with the institution in adjunct positions till 2007. Dr. Prem Krishna also had teaching assignments for an academic year each at the University of Illinois, Urbana, USA (1968-69), and, the Imperial College of Science & Technology, London, UK (1969-70).

In addition to being a committed teacher, he has been keenly active in R&D and has maintained close interaction with industry in the areas of Steel structures , Long span structures &wind engineering .

Dr.Prem Krishna has had particular interest in cable roofs and bridges. He produce the first international book entitled “Cable Suspended Roofs”, published by McGraw-Hill Newyork in 1978. The second edition was published in 2013. He has proof checked the design of numerous cable/fabric roofs constructed in India. His involvement in bridges ranges from model studies related to the Forth road suspension bridge (1961), to studies on cable stayed bridges such as the Vidyasagarsetu, complete design of the foot bridge at Roorkee and road bridge at Hardwar – being the first cable stayed bridges in India and proof checking of a number of Cable stayed bridges.

Important Professional Memberships/Positions

* Fellow (1987 onwards) and Vice – President (2008-13), Indian National Academy of Engineering
* Founder President, Indian Society of Wind Engineering (1993-2000)
* President, International Association for Wind Engineering (1991-95)
* Chairman, Research Council, CBRI, Roorkee (2010-2017)

Awards / Honours

* Life-time achievement award 2013,by the Indian Society of Wind engineering,celebrating its 20 years of establishment
* Distinguished Alumnus Award, 2012, IIT Roorkee.
* Commemorative Volume released in his honour, at the National Conference on Wind Engineering, Nagpur, February 2004.
* Many others

CABLE SUSPENDED STRUCTURES

-Potential Still Largely Untapped in India

The use of suspended systems, with ropes or cables as primary structural elements, and employing canvas or fabric in roofing, or, in traversing space as in bridges, is historically very old – may be a thousand years. It is most likely that the concept would have been evolved from examples in nature. In a more modern sense, however, using high tensile steel cables, suspension bridges have a history of about 150 years, cable stayed bridges and suspended roofs about 75 years.

High tensile strength steel cables offer the benefit of high strength – weight ratio, thus cutting down on the dead weight of the structural elements. Furthermore, when used in the suspended form, cables are the most efficient structural elements under transverse loading, only second to a tie under axial load. These two factors lead to lower dead weights in high tensile steel cable suspended structures, and, making these as a preferred choice in longer spans for which dead weights tend to become predominant. This combined with speedier construction schedules and attractive aesthetic appearance has been the reason for the popularity of such structural systems, particularly for longer spans. Cable suspended structures have been used primarily as ropeways; cable bridges – both suspended and cable stayed; roofs of stadia, aircraft hangars, airport terminals, railway platforms, atriums, exhibition halls, swimming pools; in an isolated example, for a cooling tower skin; and so on. Use of fabrics as cladding for roofs in the last couple of decades has considerably widened the scope of use of suspended structures.

It is not surprising that the countries, which are better developed industrially, have made greater use of these systems since these require comparatively higher levels of engineering skills. Countries such as the USA, UK, Japan, China, and, many countries in Europe – with Germany leading, have utilised such structures quite popularly, and, helped in developing these. Internationally, bridge spans have touched nearly 02 kms in suspension bridges (Japan), and, 1100 m in cable stayed bridges (China). In roofing systems spans close to 200 m have been achieved. India has been a slow starter, both in terms of recognising the merits of suspension structures and their deployment (mostly in cable stayed bridges and fabric roofs), as well as the spans achieved. Maximum bridge spans are around 500m.

Some special issues concerning suspended systems need to be highlighted.

1. Cable structures being inherently flexible lend themselves to a nonlinear response to loading. This presents a requirement of nonlinear analysis, different to the conventional linear one for a majority of structural forms. However, in the present day computing environment with very versatile computing packages being available, this does not present a big problem.

2. The lighter weight of suspension structures implies that wind loading is in most cases their primary design consideration. In this context, the aerodynamics of cable bridges is reasonably well understood. However, for suspension roofs, being curvilinear, the knowledge of wind loading on them is somewhat of a grey area.

3. Steel ropes are not the commonest of structural materials and thus lead to a departure from conventional materials and construction practices. In particular, issues related to cable end fittings and pretensioning, and, the accuracy involved therein require careful handling.

As mentioned earlier in this brief, we in India have been slow in recognising the merits of cable suspended systems and are hesitant to deploy them. This is despite the necessary knowhow being available to tackle these structures. However if we keep on looking beyond our shores for technical back up every time a new challenge comes up, and, do not acquire hands on experience ourselves, we shall continue to lack the confidence to deploy new technologies, including this one.