

## **New structural concepts for footbridges**

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### **Summary**

New structural concepts of pedestrian bridges are presented on examples of recently built structures. The main characteristics of described structures are appropriateness, humanity, structural efficiency and aesthetics.

**Keywords:** pedestrian bridge, structural solution, transparency, efficiency, innovation.

The architecture of a bridge should emerge from and is given by the bridge basic function. The function of a bridge is *to bridge* across some particular space in order that some load or traffic may be conveyed over a natural obstacle or another man-made thoroughfare. And the form of a bridge must express this basic function. The best structural solution should be some form inherent in the site which best fulfills the function of bridging the site. The task of the structural designer is to discover that form which can be realized in a way that is economical and efficient.

Of course, a bridge structure must be safe, should invite use, be comfortable for the user, and should be designed and constructed to human scale. Vibrations of the deck under excitation of pedestrians walking or from wind must not produce feelings of discomfort in the users.

Criteria of aesthetics are perhaps somewhat more subjective when evaluating structural concepts for bridge designs. However, architects and engineers generally agree that the whole structure and structural members forming the bridge should express by their shape the flow of internal forces through the structural system, which is integrated into the surrounding social, historical/time, technological and physical environments.

From a point of view of structural designers, each conceptual design should advance or enhance our understanding of the arts and sciences of engineering. Structural solutions

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should in some way lead to the development of new details, new processes of construction, or new applications of engineering technology.

Bridge structures are not sculptures. However, structural designs by our most excellent engineers (Nervi, Torroja, Arup, etc.) bear striking similarities to what we acknowledge to be works of art. When the conceptual design for a bridge is inherent in the setting, well executed in details, and can be easily and efficiently constructed, engineering moves from the realm of science to the realm of art.

Recently a lot of ambitious pedestrian bridges have been built. Many of them have tried to impress the public by an unusual shape, new structural system, boldness or large spans. Some structures use new material or technology of construction. But if we examine these structures carefully, we can observe that only few of them are really innovative. The main criteria of the design should be appropriateness. According to me, there is nothing new on a cable-stayed structure with a deck that is eccentrically suspended on a huge pylon without backstays although nobody has built a similar structure. There is nothing new on a glass sidewalk if it is built in the rural area that is used for equitation and if the users of the bridge have to provide the horses with special boots when crossing the bridge. Also it is nothing new if we design a structure which stiffness is given only by a space cable net if we know that there will be no maintenance. I am also not impressed by structures that use new materials if the structure has boring structural arrangement. We should always take an advantage of the material we are using and combine it in the structure in a way that give an optimum solution.

Although the unit cost of pedestrian bridges is usually higher than the unit cost of highway bridges and we should not design the cheapest, but the best solution, we should be very careful when we develop a new structure. We should always use the cost of the structure as a measure of its appropriateness.

If we carefully study recently built innovative structures, we observed that these structures take advantage of well known structural members – girders, trusses, struts, frames, arches or stay or suspension cables that combine in non traditional way. Many of them are in a vertical and plan curvature and together with arches and/or cables create space structures that enhance the architectural solution of bridges. Smooth curves of stress ribbon structures blend in to the rural environment

The paper presents the recently built innovative structures that - according to the author's opinion – solve the problem of the bridging of the site by the most appropriate way. The structures express the personal attitude, experience and deep knowledge of the designers and also confirm that *science, not intuition, is the tool of creativity*.