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INNOVATION IN BRIDGE ENGINEERING CONSTRUCTION
Introduction

• There are multiple solutions to a single engineering problem

• Our responsibility is to select the most appropriate solution for a given project

Designer as well as a contractor can introduce new ideas to increase safety, reduce cost, and improve the functionality and aesthetics of the structure

• Engineering activity is not exact science, rather more about an art
Innovation mission

• Innovation is not invention. However further development of conventional concepts to provide more value for the basic cost

• We must introduce improvement, if we want next generation to have a more enjoyable life than we have actually

• A design can be average, conventional or innovative. A designer has not fulfilled his duty, if he does not try to incorporate improvements in each of his designs. The improvement must make things better, not necessary cheaper, and especially not riskier. Conservative is not old fashioned. It means also prudent.
Reducing risk below obvious level results to unnecessarily more expensive structures.
Innovation mission

- Bridges are built with public funds and are dealing with people’s property and lives. Taking *unjustifiable risk* is not innovative, because a bridge must be safe and functional.
Innovation in procurement

• The shorter periods has encouraged procurement agencies to expect and demand ever-shorter period for delivery of a project, whilst at the same time expecting a high quality of the final product.

• Quality in the expectation of a client can be the minimum design and construction period, a deliverance on time and within client budget, minimum use of material possibility, use of durable materials at reasonable cost, easy to inspect and maintain and aesthetical structure aspect.
Innovation in procurement

• It can be seen that some of the expectations may be contradictory and not all the expectations may be achievable on a given project.

• What is however common is that no project can be delivered by use of computers alone. Deliberate human input and thought to achieve all or some of the above expectations are required.
Extensive programme of highways construction as well as railway modernization
The traditional method of procurement

- Usually an engineering firm selected by authorities not only to design, to prepare the tender documentations, to select tendered to the client, and to execute the supervision of construction
- the obvious design of bridges tended to prefer rather heavy reinforced concrete structures, and not necessarily visually attractive.
Procurement by competition method.

- Several participants in the design competition are selected from an initial expression of interest or submission of initial ideas.
- The jury assembled for judging the bridges is combination of client representative and practising engineers.
An innovative approach of procurement

The client can invite a limited number of design teams to take part in the design competition.

The competition is usually not only for ideas but require the construction method with a fairly accurate estimated construction cost.

The final result is a design best using the skills and inventiveness of the designer and builder.

The unsuccessful designers who had to expend a considerable amount of money at no recompense.
An integrated approach of procurement

Another way of obtaining the expertise of a contractor but retaining the design that the client chooses is to involve the contractor. A special partnering mechanism set-up so that savings achieved compared to the contractors tender price would be shared equitably between the contractor and client. This methodology moves away from confrontation between the design, builder and client.
An integrated design team of engineers and architects is necessary.

Adequate time needs to be given for the conceptual stage of the design.

Adequate recompense to the designer for his intellectual effort, which should not be related to construction cost of the bridge.

As design competition generates various ideas, there needs to be mechanisms for payment to non-wining designers.

There should be also mechanism for sharing possible risks associated with new and unique designs between the designer, builder and owner.
Progress in bridge construction

Remarks on innovations

As engineers, we have to study and fellow various specifications and codes. However, these are not natural rules only their approximation. Thus, they can be changed. Consequently, we may understand that respecting them is not always correct.

There is sometimes opportunity to introduce new ideas or overcome restrictions. When we are sure that we do not have to follow what other people have established, the opportunity is open.

But it is not possible progress over certain boundaries. We should verify that our innovation is enough safe and appropriate.
Participation of decks elements within the main truss or girders

✓ reduce stresses in the main members as much as 10 or 20 percent
Steel railway bow-string in B. Bystrica over Hron river
Advanced design of composite steel and concrete structures
Model 3
Separate member model
+ infinitely stiff transverse redistribution

Model 2
Grid member model
detail

Model 1
Combine plate-member model
rendering
orthotropic steel-plate floor
Steel railway truss bridge in Streda n/Bodrogom over Bodrog river
Filler beam deck
Concluding remarks

- **Innovative** design does not mean to take extra risks.

- But **conservative** does not mean to accept less risk either. Ninety percent safe is equivalent to ten percent of risk. Probabilistically, there is not fully safe structure. Many of structural elements are designed for loads with a certain probability, which is far from zero. But this is probability or risk, which society should accept.
Concluding remarks

• Reducing risk below accepted level not necessarily results to the safer structure. It may just mean to produce the structure unnecessarily more expensive.

• As a result, to be conservative is important, but being excessively conservative is not appropriate.

• Obviously the determination of the partial safety factors is not very sophisticated. There are the products of a time dependent compromise among the experts.
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Total investment € 3 mil.
Innovative Learning System

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Thank you for attention.