POLITECNICO DI TORINO
FIRST SCHOOL OF ARCHITECTURE
Master of Science in Architecture Construction City
Honors theses

Cycling and pedestrian bridge over the Sesia river

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The plan of this bridge has been, for us, an opportunity to try out the use of innovative methods and developing skills concerning structural and architectural fields.
The work theme is the project of a footbridge over the Sesia river, not far from Greggio.
The bridge will be part of a European program of facilities, known with the name of "veloroutes8" that is expected to connect Cadiz to Athens. This bicycle net would connect all European countries among each other. An alternative proposal of the Italian participation in the program, was the creation of a beautiful path through the rice lands of the Pianura Padana. "Canale Cavour" is the name assigned to the historical landscape.
"Canale Cavour" is a masterpiece of cultural heritage of these lands. It consists of an hydraulic net, 85 kms long whose construction was ended in 1846 by the newborn Italian kingdom.
It is composed of 101 bridges, 210 "tombe- sifone" and 62 "ponti canale". This net is still working correctly nowadays without any problem.
Our target was the project of a bridge that, once Canale Cavour had been directed (inside a gallery) below the Sesia river, could permit veloruoters' passage fig.1A .

Fig.1A: The project site from an aerial view; Fig.1B: The river bed's width watched from the space between high speed train bridge(in the left) and the A4 highway bridge(in the right)

On further investigations , some important themes have emerged. Using these new details, we have defined the guidelines useful for planning the bridge into the right context of the site.

- **Connections between facilities and the bed of the river.**
  Sesia river is characterized by frequent flooding , that means that structural elements have to hold out against the impact of debris and the force of water.
- **Connections among facilities.**
  The new bridge has to be integrated among other facilities already existing in the site. It has to interact with them.
- **The protected path.**
  This bridge shouldn't be only a flat surface to cross the river but it should also provide a protected structure for people.
- **Slow mobility has to compensate fast mobility.**
  All slow mobility users must have the possibility of discovering these beautiful lands to become owners of that broken-up area which is consequence of the high speed market requirements.

- **Dignity of slow mobility facilities.**
  Slow mobility facilities must be studied with the same attention used for planning fast mobility bridge.

These themes have leaded us to the project of a parasitic structure which could exploit space between the high speed train bridge and the A4 highway bridge. The result is a suspension bridge lacking in foundation piles which hangs down other two bridges.
These choices gave us the possibility to solve all issues related to river's flood . Besides, we used again a residual space.
To face the suspension issue we decided to use a structure based on the principle of the "net-cables".
The final project is a result of several steps. The first one consisted in: experimenting with concept's maquette, the study of the physics of the spiderwebs, tensegrity and net-cables structures fig.2A .
We concluded that tensegrity structure was what we needed for our architectural issue.
As a second step, we studied in a deep way the theoretic discussion about resolution of equilibrium problems of tensegrity structures. We studied also the procedures of form-finding. Through the use of computer devices and systems such as Grasshopper, Kangaroo and Oasys GSA, we made a virtual model of the bridge.
Finally, using all programs together , we found the right algorithm to optimize the full project from an architectural and structural point of view. It is possible to see it from the final designing fig. 2C fig.3A.

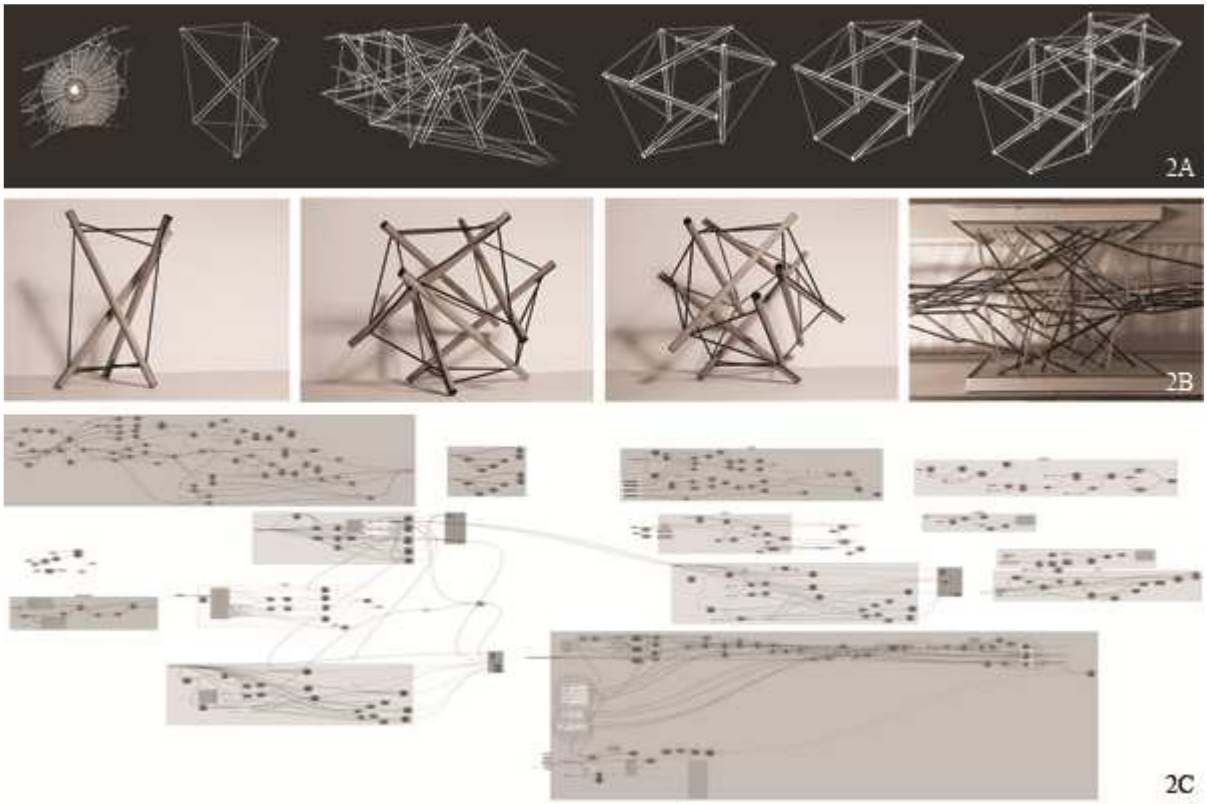

Fig.2A: Studing sketches; Fig.2B: Maquette for the physics study of the equilibrium in tensegrities and net cables structure; Fig.2C: optimization algorithm written in Grasshopper that interface GSA, Excel, Rhinoceros, Grasshopper

As final result we obtained a bridge which is a blending of architecture and structures based on:

- absence of foundation piles,
- a cable structure stiffened by strut elements (tensegrity),
- structural elements with a reduced section (optimization).

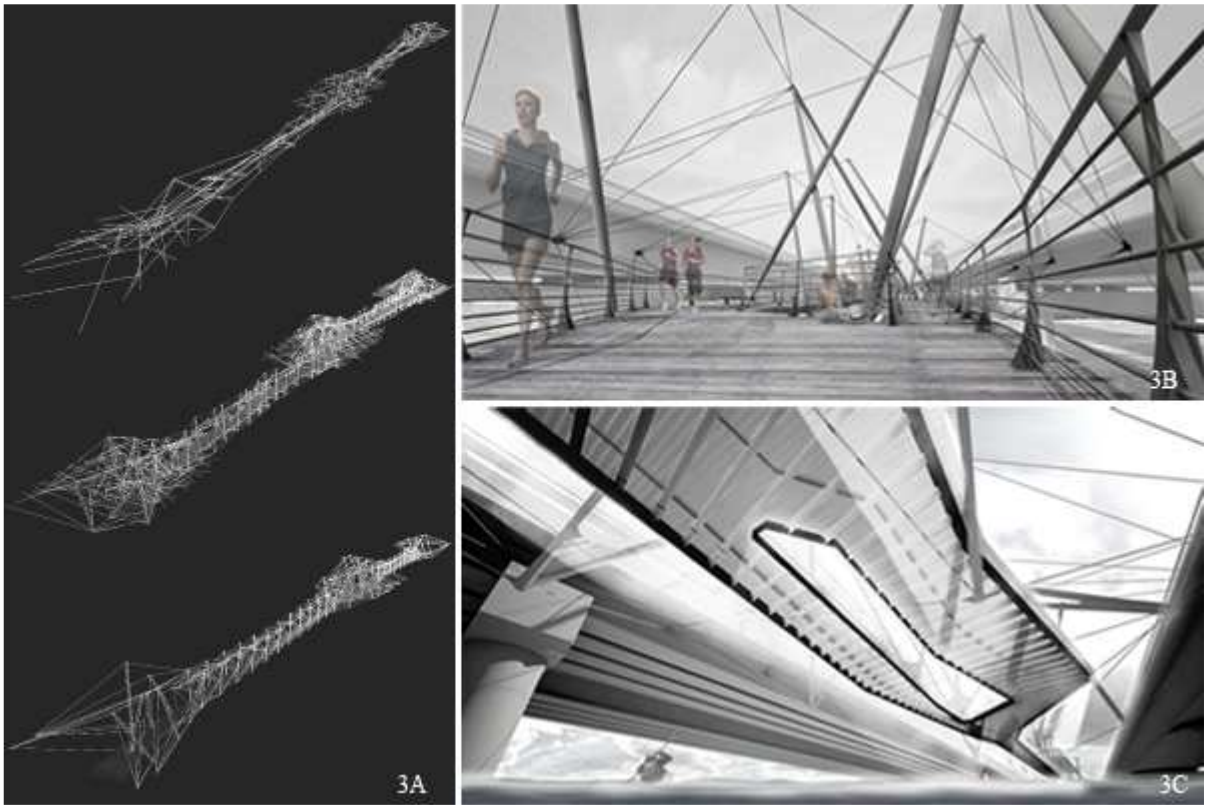

Fig.3A: Sketches resuming the optimization process ; 3B: Render view from the interior of the bridge; 3C: Render view below the bridge's deck at the water level

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