Knowledge of the different roofing systems typologies in a public complex of XX century: geometric survey and material investigation

Francesco Augelli [1], Anna Anzani [2,] Lorenzo Cantini [3], Paola Condoleo [4], Antonia Gobbo [5], Roberta Mastropirro [6]

An articulated procedure has been applied for the structural and health assessment of the roofing systems of a public complex built at the beginning of XX century, eventually aimed to the safeguard of a relevant part of a valuable architectural heritage.
The trusses spanning over large rooms present different typologies and sometimes are bearing brickwork vaulted structures hanging below. The very complex constructive system characterized by trusses of different tipologies was analysed through a careful photographic and 3D direct geometric survey. The geometry of every attic was therefore reliably traced to understand the features of the structural elements and their connections.

Figure 1 - Plan of the studied complex.

Figure 2 - Truss E3_a1-$C9_3$ of building 3.
Figure 3 - Truss E3_a1- $C10_4$ of building 3

A comparison between the different building solutions adopted in the different parts of the construction and a recognition of the types of connections between the hanging devices and the timber trusses has been carried out (Figures 4 -6). Most of them are built in timber, in few cases reinforced concrete was used. Above the main rooms, trusses of bigger size and higher complexity are present. In many cases the timber trusses of the studied roofing systems spanning over large rooms are bearing brickwork vaulted structures hanging below. The large structures, partially hanged to the timber

[1] Francesco Augelli, DPA – Politecnico di Milano, Italy, faugelli@polimi.it
[2] Anna Anzani, DIS – Politecnico di Milano, Italy, anzani@stru.polimi.it
[3] Lorenzo Cantini, DIS – Politecnico di Milano, Italy, cantini @stru.polimi.it
[4]Paola Condoleo, DIS – Politecnico di Milano, Italy, condoleo @stru.polimi.it
[5] Antonia Gobbo, DIS – Politecnico di Milano, Italy, gobbo @stru.polimi.it
[6] Roberta Mastropirro, DPA – Politecnico di Milano, Italy, robertamastropirro@inwind.it

trusses of the roof, are extremely deformable. They are characterized by a nearly flat central sector, supported by iron beams, buttress walls on the extrados, and hanging devices to connect the vaults with the roofing trusses.

Figure 4 - Trusses of building 4

Figure 5 - Trusses of building°8

Figure 6 - Trusses of building 7

By local inspection two kinds of connections between the vault and the roofing system were recognized. The first type, like those adopted in the case of the hanging devices shown in Figure 7, consists of metal strips bolted to the beam web. The second one, shown in Figure 8, consists of metal strips wrapped below the upper beam flange.

Figure 7 - Connection between timber truss and I beam through strips bolted to the web.

Figure 8 - Connection between timber truss and I beam through strips wrapped around the flange, with no bolting.

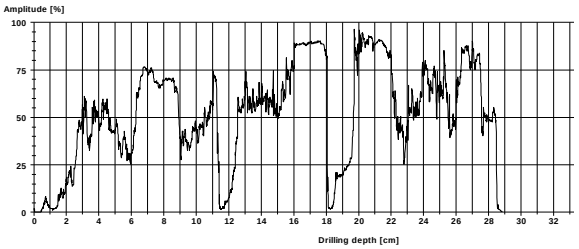
Direct inspection of the structural elements has been performed in order to identify the timber species, their principal defects, macroscopic pathologies and class of biological risk.

Where needed, penetrometric characterization of the wooden elements with evident damage was carried out and the ratio between the calculated resistant profile (Pr) and the total measured profile (Pt) allowed to highlight two risk classes.

Critical situations have been evidentiated through both visual inspection and penetrometric profiles.

a)

b)



c)

Figure 9 - Testing the timber roof: thermo-hygrometric survey a), ultrasonic test b), diagram obtained from penetrometric test c).

Keywords Roofing systems, connection devices, material pathology, diagnostic techniques.