

# STSM report COST FP1404

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**Exchange:** VSB-Technical University Ostrava to Byggnadstekniska Byrån

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**Purpose:** The main purpose of this STSM is to provide data collection for postprocessing and to prepare Case Study about fire of Royal Institute of Art.

## **Short Summary:**

The STSM was focused on post fire investigation of Royal Institute of Art, 5-story building more than 200 years old. As constructed from both bricks and timber elements, there were observed unusual fire spread and development phenomena during the fire. The fire was spreading in cavities without noticing after first extinguishment. In such dangerous situations especially for timber buildings, a case study for specialists fighting fires and their safety is highly important. Therefore, following procedures were used:

- Data collection about the structure and fire – photos, measurements from the fire scene.
- Gathering experiences and information about intervention.
- Interview with stakeholders – fire-fighters, fire designers and representatives of fire protection association focused on fire safety protection of timber buildings.

**Main Results:** Data and experiences collection from firefighting attack and fire investigation reports of the burnt building. Additionally, more information was collected from interview with commanders of fire-fighters. These data are beneficial for work of WG3/TG1 of COST Action FP1404.

The collaboration between the three Swedish organisations (Byggnadstekniska Byrån, Brandskyddsföreningen Sverige and Storstockholms brandförsvär) and VSB-University of Ostrava will continue to exchange valuable experiences and information in specific topics mainly in fire safety protection and firefighting in timber buildings.

Collected information will be published and presented as a Case Study. Analysed data will be used for further experiments and research purposes.

## **Annex 1 – Confirmation by Host Institution**

I received the report and I confirm all information are truth and I approve its publication.

Sincerely,

**Elzbieta Lukaszewska**

Structural Engineer

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## **Annex 2 – Scientific Report**

Fire safety use of bio-based building products



# **Post fire investigation of timber elements in a Stockholm building**

Scientific report of STSM at Byggnadstekniska Byrån,  
Stockholm, Sweden

24.03-30.03.2018

Author:

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# Introduction

Fire of old building with flammable elements can very easily result in difficult conditions for fire-fighters during fire attack and extinguishing procedures. Experiences from fires in various old buildings are beneficial for fire-fighters to learn what could happen and how to react. This knowledge can be implemented in fire-fighting procedures, decision making process etc. The work perform within this STSM offers also deeper view about hazards in old buildings in frame of structure's fire safety protection.

This fire provided valuable data and information about:

- Fire spread in attics
- Fire spread through external vents
- Smoke hazards

Experiences from this type of fire with timber elements are very beneficial for fire-fighters. This fire represented specific conditions during a fire and affect fire development and make it more complicated – e.g. fire spreading in attics, smoke ignition, etc.

## Personal and Professional Growth

The visit of Stockholm started by meeting with hosting structural engineer - Elzbieta Lukaszewska, representative of Byggnadstekniska Byrån. Elzbieta was responsible for the building after fire. Then, site investigation and further meetings with stakeholders followed.

### *Personal and Professional Development:*

- Improvement in communication skills
- Discussion and interviews with professionals in area of fire safety and building construction led to better understanding of stakeholders' roles and cooperation
- Application of gained experiences and knowledge in post fire investigation
- Application and verification of own knowledge about fire-fighting and structure engineering allowed development of self-confidence in practice
- Gaining new knowledge and experiences in frame of post fire investigation and working on building site, processing and analysing of fire-fighting reports
- Development of knowledge about fire-fighting tactics and procedures in Sweden, allowing comparison with conditions and procedures in other countries, too
- Better understanding of structure fires with old, flammable construction

# Building Specification

## The Royal Institute of Art

The building, also known as the Båtsmanskasernen - barrack II, is located in Skeppsholmen, central Stockholm. The building was built in 1816-1819 and housed 200 boatmen and 40 fishing boats. The building was founded on an already commenced but never completed artillery city. The majority of rebuildings have been carried out over the years, during the 1870s a major rebuilding of the barracks was carried out, as it included escalators to the east and also an outhouse length with two side mirrors. In 1892 a shooting pavilion was added. In 1907 the façade changed by enlarging the windows. (Statens fastighetsverk, 2016).

The building consists of six floors including basement and wind. Roof top with wooden roof consists of sheet metal, plywood, insulation, PVC foil, plaster, wood and beams. Internal steel piles hold up the roof structure together with interior walls. The outer walls consist of bricks and tiled facade. Parts of the interior. The walls of the wind consist of easy-to-handle construction of wood, plaster and insulation. The wind beam consists of wooden beams, bricks, 2 layers of wood floors / boards and lime gravel. See Figure 1. (Royal Building Agency, 1987)[1][2]

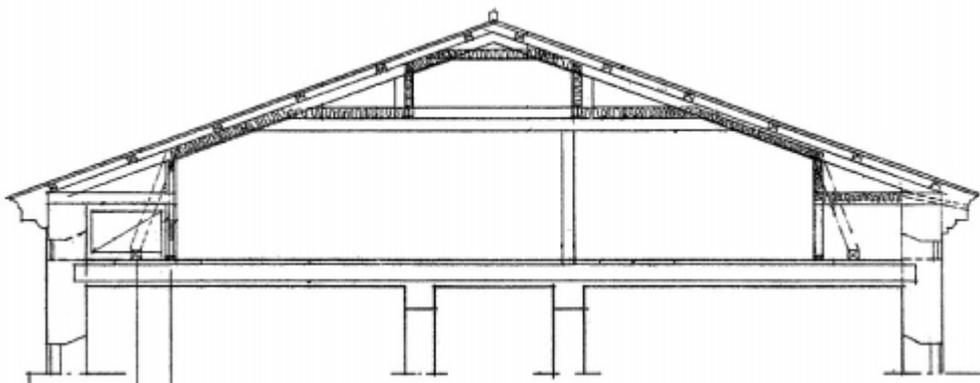


Figure 1: Roof Structure [1]

# Overview of performed work

During the STSM realized in Stockholm it was decided to collect as much information about experiences with fires in old buildings with bio-based materials (e.g. wood) as possible in order to gain data for the COST Action FP1404, WG3, TG1. The case of fire in Royal Institute of Art described experiences in fire development, fire spread and consideration of fire-fighters.

After analysing the situation on site, stakeholders in this problematic were asked for discussions. Firstly, it was necessary to get information and experiences from firefighting this type of buildings. Therefore, meetings with a commander of fire-fighters who led extinguishing procedures in the building during fire were organised. When there is a fire, it is too late to think about how the building should be organised before. It was decided to talk with an engineer responsible for reconstruction of building after fire and representatives of fire protection association in Sweden followingly, to discuss more information about general conception of fire safety and specific requirements about old buildings.

## Researched Information

For purpose of preparing case study of this fire, it was necessary to talk with stakeholders about fire of Royal Institute of Art and about fire safety protection of timber buildings in general. These organizations were:

- *Byggnadstekniska Byrån* – Construction company responsible for reconstruction of the burnt building
- *Storstockholms brandförsvär* – Fire and Rescue Service responsible for fire attack and extinguishing procedures of the building
- *Brandskyddsföreningen Sverige*

## Storstockholms brandförsvär

A fire engineer and responsible person for fire investigation of Royal Institute of Art - Daniel Olsson was contacted. Based on discussion with him, Report of fire-fighting procedures and Report of fire investigation as well as valuable information were gained. Following draft describes researched information about fire of Royal Institute of Art.

### 1) Fire Scenario

- a) Design of fire scenario
- b) Fire Development
- c) Interesting information about fire spreading and its development
- d) Impact on Structure

**2) Structure elements' response to fire**

- a) Impact of fire
- b) Fire spread in building
- c) Description of the fire building and its structure

**3) Fire-fighting Procedures and Experiences**

- a) Rescue and fire-fighting procedure description
- b) Equipment and Impact on Fire Spread
- c) What important decisions were made by the commanders
- d) How did building-technical fire protection work

Additionally, meetings with Barry Levis, responsible fire-fighter for leading rescue and fire-fighting procedures were organised.



*Figure 2- Extinguishing the attic fire [3]*



*Figure 3 – Extinguishing from the roof [4]*

**Byggnadstekniska Byrån**

The company is responsible for reconstruction of the building after fire. The meeting was arranged with Elzbieta Lukaszewska – engineer and representative of company. During the meeting information about fire, building and reconstruction were obtained. Collected information included plans of the building and used materials.

Important part of the meeting was visiting the conserved site. On the place, photos, videos and measurements were taken. Some of the samples were prepared to be shipped for further

research and investigation at the technical University of Ostrava. Main findings are expected in area of structure elements affectation by extinguishing water.

### **Brandskyddsföreningen Sverige**

The Swedish Fire Protection Association deals and develops concepts of fire safety prevention in Sweden. Employees of this association have large experiences with structural fires including timber buildings. Main goal of the long discussions was to exchange experiences with fires of timber buildings and fire prevention, highly valuable for the case study preparations as well as for considering fire prevention of timber buildings.

## **Results and discussions**

The fire was interesting in several points of view. The first view considers fire safety protection of historical buildings, where material properties and structure are unknown during the fire. Information and experiences gained from this fire are helpful for further similar fires.

*Some of important hypothesis from the STSM:*

- Mechanism of fire spread and definition of critical places of old buildings with bio-based materials involved
- Impact of extinguishing water on timber structures
- Experiences from fire-fighting
- Important information for decision making during a fire attack

To get more information about mentioned tasks, following documents from the fire were important to study.

### **Documents**

The most important documents the case study preparations:

- Fire-fighting report
- Fire investigation report
- Plans of the building

These documents have been provided by fire and rescue service and Byggnadstekniska Byrån.

### **Discussions**

Very valuable information has been collected with representatives of each organizations. This information will be used with documents for analysis and preparing of case study.

### **Measurements**

The building has a very high value for Swedish people and culture. Therefore, it was decided to reconstruct it. Up to the time of this STSM, all the building was protected and heated against cold and wet weather and it was possible to take measurements on the site. These measurements included charring rates, material properties, lengths, etc. These data will be valuable for the case study preparations as well as for further fire modelling and calculations possibly.

### **Samples**

- Samples of beams
  - o Affected by water
  - o Affected by fire

Gained information will be used to prepare the case study. This case study will be included in work of WG3/TG1 – Fire-fighting and bio-based materials of COST FP1404. Additionally, it will be summarized in journal papers.

## Conclusions

In case of a fire, flammable elements in buildings represent possible complications for fire-fighters during their extinguishing procedures. This fact is more complicated in case of fire old buildings, where construction is usually unknown for intervening units.

During the investigation of fire of Royal Institute of Art in Stockholm (Sweden), a number of interesting and valuable information about fire development, fire-fighting and reconstruction were seen.

STSM was focused on collecting information and experiences from the fire of the royal Institute of Art. For collecting as much information as possible, site visits for pictures, plans and measurements were organised thankfully to this STSM possibility. This mission was hosted by and because of doctor Elzbieta Lukaszewska from Byggnadstekniska Byrån, who is also responsible for reconstruction of the building.

Ms Elzbieta Lukaszewska arranged contact with Daniel Olsson, responsible investigator and fire engineer from Storstockholms brandförsvaret and meeting with Bart Levis, a commander of intervening and emergency units. Discussions and data collection about their real experiences from the fire followed. It was important too to get information about fire development and decision-making procedures.

Additionally, meeting with Swedish Fire Protection Association (*Brandskyddsföreningen Sverige*) was arranged. There were discussed experiences with fires of timber buildings and extinguishing in Sweden.

During the meetings materials such as reports, photos, videos, samples and plans which will be used for preparing of Case Study for COST Action FP1404, WG3/TG1 – Fire-fighting and bio-based were collected and discussed with people involved. Some of new questions raised e.g. about fires in timber buildings and especially in old buildings, related fire hazards, impact of extinguishing water on timber elements, etc. These questions will be deeply investigated and researched.

## References

- [1] OLSSON, Daniel. Fördjupad olycksutredning: Brand på Konsthögskolan, Skeppsholmen. Sweden, 2017.
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