CONSTRUCTION HISTORY IN BELGIUM

Interuniversity Research Seminar January 14th, 2022

Book of abstracts

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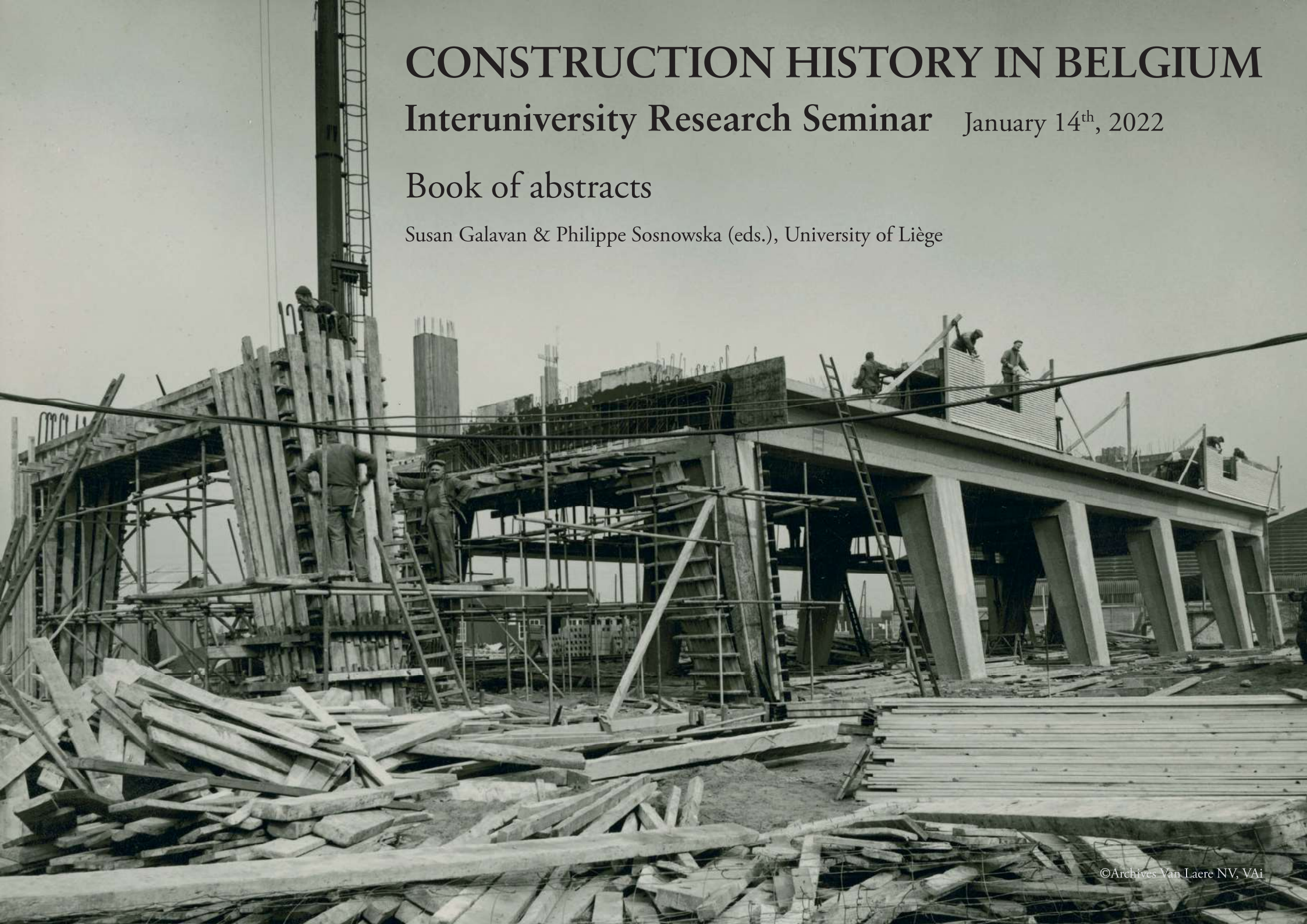

The Faculty of Architecture ULiège is pleased to host the third Interuniversity seminar on Construction History in Belgium on January 14th 2022 (online).

This book of abstracts summarises the research which will be presented at the seminar. It represents work from five universities across Belgium (Université libre de Bruxelles, UCLouvain, Vrij Universiteit Brussel, Universiteit Antwerpen and Université de Liège). The seminar provides the opportunity for researchers to discuss ideas, form new collaborations and to benefit from the input of international experts in the field.

We would like to thank the participants for their contributions, as well as Prof. Conor Lucey (University College Dublin) and Dr. Louis Vandenabeele (ETH Zurich) who have kindly agreed to act as external reviewers during the seminar. The event will conclude with a round table and the launch of Jelena Dobbel's new book *Building a profession: a history of general contractors in Belgium (1870-1970)*, published by VUB Press.

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9:15 **WELCOME & INTRODUCTION**

Dr. Susan Galavan (ULiège) and Dr. Philippe Sosnowka (ULiège)

9:30-10:15 **LECTURE**

Prof. Conor Lucey (University College Dublin), *Builders as designers: row housing in British architectural culture, 1750-1830*

10:15-10:30 Break

10:30-12:30 **IN DEPTH INVESTIGATIONS** [15 mins each + Q&A]

Referees: **Prof. Conor Lucey** (UCD) & **Dr. Louis Vandenabeele** (ETHZurich)

Matthijs Degraeve (VUB), *Transient or resilient? Firm longevity in the construction sector, Brussels 1830-1970*

Jelle Angillis (UAnt), *Kiel social housing complex: a rational construction on pilotis*

Lyna Bourouiba (ULB), *'Zero degree' in the work of Hiromi Fujji (1933): neutralizing authorship and 'neutriser' architectural language*

Shuyuan Han (UCL), *Rigid Frames Origin, Development, and Application*

12:30-13:30 Lunch

13:30-14:30 **PITCH PRESENTATIONS 1** [5 mins each + Q&A]

Lara Reyniers (VUB), *From deconstruction to destruction and back. Demolition entrepreneurs in the urban context of Brussels (1850 – 2025)*

Joke Van Houwenis (UAnt), *Intelligent ruins: the reusability of existing buildings*

Baptise Drugmand (ULiège), *Railway passenger shelters in Belgium: development of roof structure typologies*

PITCH PRESENTATIONS 2 [5 mins each + Q&A]

Louise Huba (VUB), *The premature demolition of large-scale buildings in Brussels (1987-2022)*

Tuba Bölük (UAnt), *İshak Efendi and the discursive construction of modern engineering knowledge in the nineteenth century Ottoman Empire* (online)

Robbe Pacquée (UAnt), *Porosity of Building Structures: Tracing changes to the circulation and functional layout of converted buildings*

14:30-15:15 **LECTURE**

Dr. Louis Vandenabeele (ETHZurich), *Building the domes of the basilica of St Anthony in Padua*

15:15-15:45 Break

15:45-16:15 **ROUND TABLE**

Prof. Ine Wouters: State of the art and new initiatives

16:15-16:45 **BOOK LAUNCH**

Building a profession: a history of general contractors in Belgium (1870-1970) by Jelena Dobbels

16:45 Closing remarks

The Origin, Development, and Application of Hyperstatic Rigid Frames

Shuyuan HAN | Faculty of Architecture, Architectural Engineering, urbanism (LOCI), UCLouvain

PhD project: *Hyperstatic Rigid Frames: Historical and Design Approaches*
Supervisor(s): Denis Zastavni (UCLouvain)
2018-2022 | China Scholarship Council

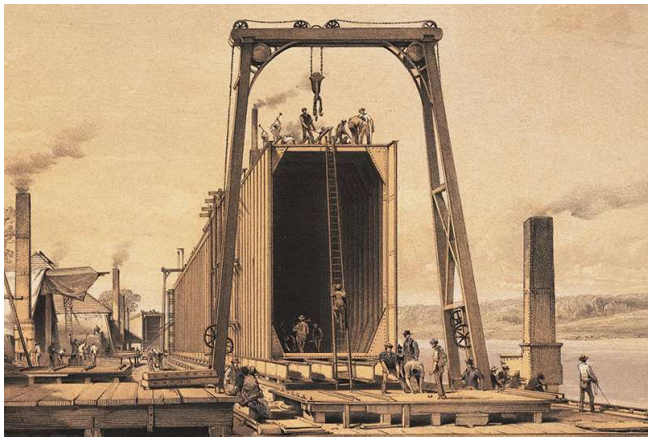
The research presented in this seminar is the first part of the author' PhD project. This project is comprised of two parts: a history study of hyperstatic rigid frames, and developing the historical analysis method graphic statics into a geometric-based design method for hyperstatic rigid frames.

Hyperstatic rigid frames are frames characterized by moment-resisting connections and static indeterminacy. Despite their ubiquitous use nowadays, some questions related to the history of their origin, development, and application are still unclear. The first part of the project tries to answer these questions through the investigation of archival evidence. The review of the historical graphical method also provides the foundation for the second part of the project.

An overview of the historical research of hyperstatic rigid frames

The intent of the history study is to reveal how new materials, spatial need, new construction technologies and structural theories have advanced the development and application of hyperstatic rigid frames.

This kind of frames had already existed before the first industrial revolution. Ancient wooden ships used bracing knees in joints. The members could thus resist bending together, the ship frames became stronger and more integrated. During the age of first industrial revolution, the increasing need for prompt construction promoted rigid connections. The frame of the Crystal Palace derived its stability from rigid connection during construction. Without the supporting falsework, the construction became faster. Many iron frames at that time adopted brackets or curved girders in joints to realize the moment-resisting capacity, imitating the strategy of timber frames. It is believed until the Godfrey Greene's Royal Navy Boat Store that the rigid connection finally had its modern elegant construction. Then with the burgeoning high-rise building in Chicago and New York in the late 1860s and 1870s, the demand for reducing floor area occupied by thick masonry walls gave an impetus for the adoption of "portal actions" to resist lateral loading. For example, the Old Colony Building built in the 1890s was laterally braced by its sophisticated portal arch system. With the extensive application of steel and reinforced concrete in building industry, the elegancy and simplicity of the rigid joints became more effortless to achieve. Electric welding and high-strength bolts further simplified the detail of steel frames. Meanwhile, pioneering architects and engineers were exploring the potential of visual expression of hyperstatic rigid frames.



Detail of Britannia tube on shore (Source: C., E & R. Stephenson, *The Britannia and Conway Tubular Bridges*,1850, Linda Hall Library).

The structural theories had also been evolving along. At the time of Renaissance, Leonardo da Vinci was able to illustrate the basic bending action of portal frames. Then at the time of first Industrial Revolution, analytical methods advanced continuously with the introduction of mathematical means like calculus and matrix. At the beginning of the twentieth century, the force method and the displacement method quickly reached their limits with the blossom of high-rise building. To address high degree of static indeterminacy, iterative methods such as those of Hardy Cross was proposed and extensively used. Besides the well-known numeric methods, geometric-based method graphic statics was also developed and applied on hyperstatic rigid frames by some researchers. Milo Ketchum and Jerome Sondericker devised methods that could solve portal frames partly rigid. William Wolfe adapted Otto Mohr' method to solve a three-degree-indeterminate continuous portal frame under vertical loading. Though almost forgotten, these graphical methods can offer special insight into the relation between structural definition and bending performance.