Preventive Conservation in Historic Houses and Palace Museums: Assessment Methodologies and Applications

SilvanaEditoriale

Preventive Conservation in Historic Houses and Palace Museums: Assessment Methodologies and Applications

Conference of the National Museum
of the Palace of Versailles (EPV),
the Association of European
Royal Residences (ARRE),
and the Research Centre
of the Palace of Versailles (CRCV)

In collaboration with the International Committee
for Historic House Museums (DEMHIST),
held at the National Museum
of the Palace of Versailles and Trianon

From 29th November to 1st December 2017

Conference Proceedings

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Thanks to

Lorenzo Appolonia, Lionel Arsac, Jean-Vincent Bacquart, Wojciech Bagiński, Jérémie Benoît, Marie-Alice Beziaud, Céline Boissiere, Anne Carasso, Élisabeth Caude, Gabrielle Chadie, Thibault Creste, Stefania De Blasi, Elisabetta Brignoli, Hélène Dalifard, Gaël de Guichen, Ariane de Lestrange, Festese Devarayar, Françoise Feige, Christophe Fouin, Éric Gall, Thomas Garnier, Roberta Genta, Denis Guillemard, Michelle-Agnoko Gunn, l'équipe du Grand Café d'Orléans, Pierre-Xavier Hans, Nicole Jamieson, Thierry Lamouroux, Marie Leimbacher, Nadège Marzanato, Béatrice Messaoudi, Stefan Michalski, Christian Milet, Marya Nawrocka-Teodorczyk, Marco Nervo, Lucie Nicolas-Vullierme, Clotilde Nouailhat, Agnieszka Pawlak, Amaury Percheron, Arnaud Prêtre, Gérard Robaut, Bertrand Rondot, Valériane Rozé, Béatrice Sarrazin, Béatrix Saule, Didier Saulnier, Emma Scheinmaenn, Violaine Solari, Emilie Sonck, Pauline Tronca, Rémi Watiez, Thierry Webley, Sébastien Zimmerman

With the patronage of

Portuguese Presidential Palace's Structural Weaknesses Survey

Abstract

The Palace of Belem was a Lord's Country House, started to be built in the 16th century, mainly built in the 17th century and with a lot of additions and changes until the 20th century. In 1726 the Portuguese King John V bought the House and it became a Royal small palace until 1910. After the Republican Revolution, the palace became the Presidential Palace of Portugal.

Being the Head of State's Office, the palace is a political centre, and a place of representation of the State, receiving representative guests from all over the World.

Because of its old construction, stability was designed by ancient methods. In 1755 Lisbon had a huge earthquake and most of the buildings afterwards were built using a new anti-seismic system. Belem was not affected by this earthquake, but the building was built before these concerns.

On the Presidency's demand, the National Laboratory of Civil Engineering (LNEC) made in May 2014 a structural weaknesses survey in order to identify possible damageable areas in case of an earthquake.

This survey aims to assess the risk and give the right information to the preventive structural reinforcements, which will have to be done in the respect of the Heritage Conservation principles.

Keywords

Presidential Palace, structural survey, risk assessment, reinforcements.

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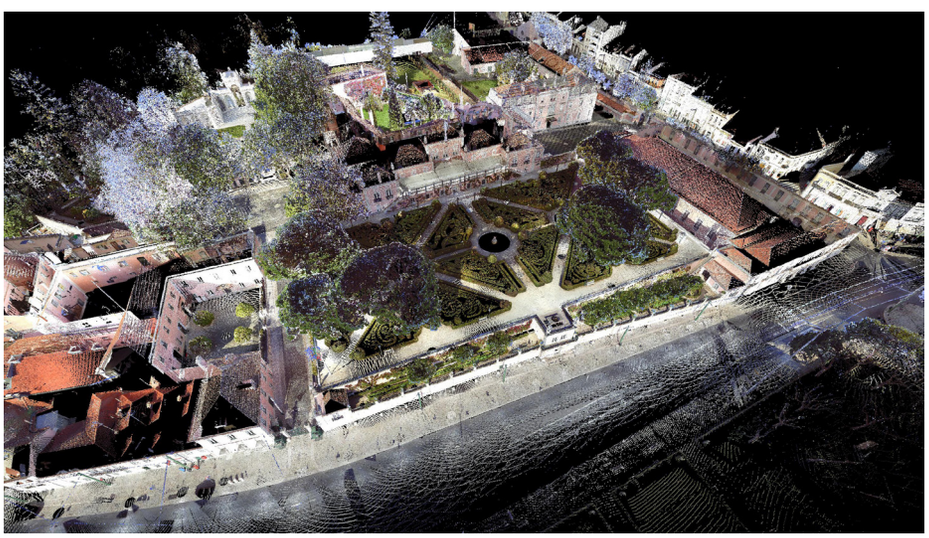

Fig. 1
Point Clouds: 3D laser scan and digital photogrammetry (381.5 M points), ArcHC_3D Research Group, FA, Univ. Lisbon.

Context of the Building

Being the President's official office, the palace has been for more than a century a political centre, a place for ceremonies for the representation of the State, receiving major political guests from all over the world. Because there is the Presidency's Museum inside, the compound receives public every day, especially on weekends, when all the major ceremonial rooms are open to public visits.

Regarding all this context, stability and structural security is vital for the preservation of the cultural asset and as part of the global security of the users and guests.

But because of its old construction, stability was designed by ancient methods and techniques, using traditional materials. In 1755 Lisbon suffered a huge earthquake, estimated to have been a level 9 earthquake in Richter Scale. Due to the collapse of almost all the buildings in town centre, all the new buildings afterwards were built using a new anti-seismic system, called "gaiola pombalina," a type of wooden 3D grid named after the Prime Minister of the time, the Marquis of Pombal.

The Survey

On the Presidency's demand, the National Laboratory of Civil Engineering (LNEC) made in 2014 a structural weaknesses survey to identify possible damageable areas in case of an earthquake. A virtual 3D vector model was made to assess seismic stability. Some vulnerabilities were then identified and needed further analyses.

A 3D scan made in 2011 (fig. 1) was used to manipulate the entire complex as if it was a model, allowing to see it from several different perspectives, including 2D elevations and finding problems that were invisible from the ground. Some distortions found in the exterior walls of the main rooms were noticed at the time and became under surveillance. After 7 years, another 3D scan was done to the same problematic areas to monitor its evolution.

After the final LNEC report, a formal procurement within experts of this construction system from Portuguese Engineering Universities was made to design the structural reinforcements. The work was commissioned to the "Lest," The Structure's Laboratory of the Minho University.

Before starting to define reinforcement solutions, a very much detailed survey was made by a Research Team of Minho University to identify the strength, the modulation, the conservation state, the joints and the sanity of each piece in order to get the perfect characterisation and definition of every component. Moderately destructive tests like flat-jacks (simple at first and then double) and cores (wall samples) were made, as well as non-destructive tests like resistograph tests, sonic and radar tests, thermographic camera pictures, humidity measures,

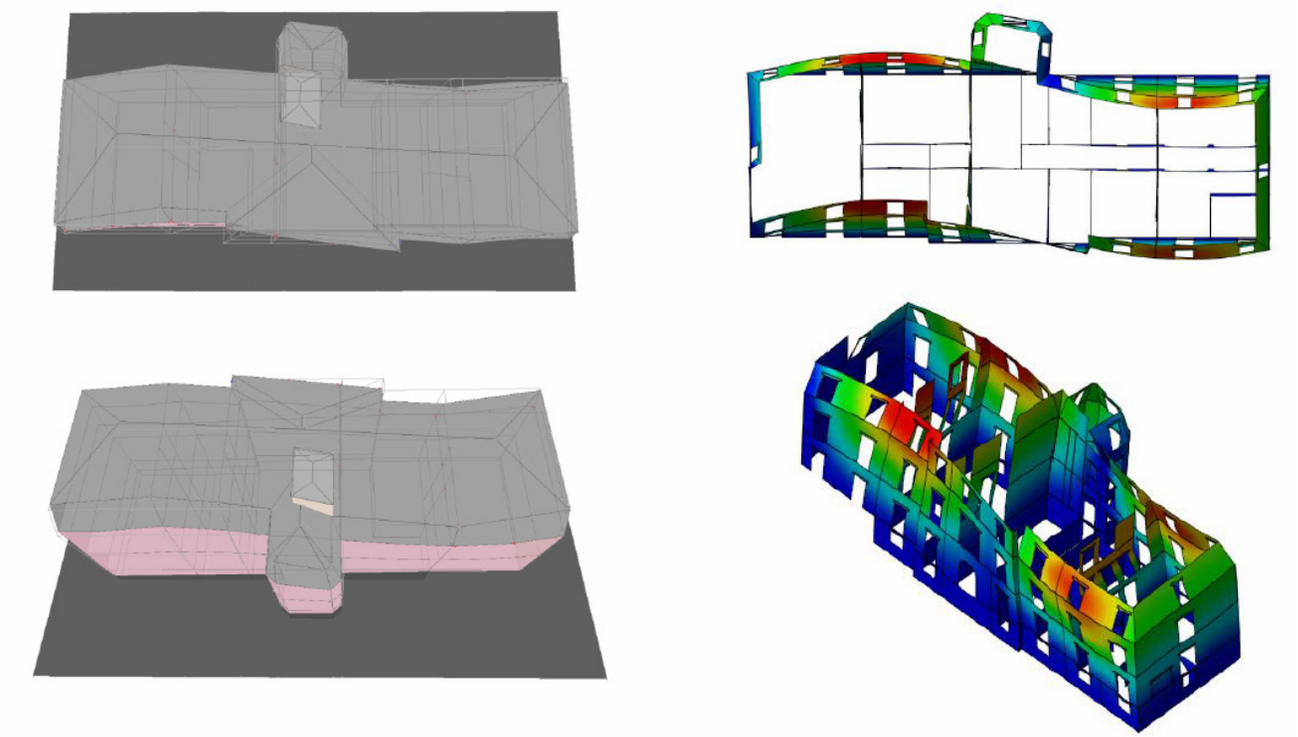

Fig. 2
Experimental results and mode shapes from modal analysis, Inst. Sustainability Innovation in Structural Engineering, University of Minho.

etc. The cores were taken to the Minho University Laboratory and compressed until collapse, in order to know its resistance. This information, with all the other data from the survey was photographed, listed and then gathered into a 3D model, virtually shaken to estimate the structural behaviour of the buildings in the case of an earthquake (fig. 2).

Conclusion

Culturally relevant assets built in seismic areas such as the Portuguese Presidential Palace example need special attention to its stability and physical integrity. Estimated structural behaviour needs study in order to assure that minimum conditions of safety, both for the preservation of the cultural asset and for the people inside, will prevail in an event of an earthquake.

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