
COMMENTARY

3D Laser Scanning of Heritage Areas after Earthquakes: San Lorenzo de Tarapacá, Chile

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The images show a record done in January 2013 using a three-dimensional (3D) terrestrial laser scanner, technology that allows obtaining a point cloud with precision of millimetres. It combines laser measurements and photographs to build a colour and accurate 3D model of the current state in a short period of time, which can be edited and used as a basis for assessment and further design. It is a three-dimensional representation of the specific state of a place that allows us to virtually transport ourselves to it, to walk it, to observe it, to dimension it and to study it. Because of that, this technology could be considered as a very powerful tool for intervention and reconstruction processes after earthquakes, which occur regularly in the country. During three days on site, two persons scanned the heritage area of San Lorenzo de Tarapacá from its streets, including some interior spaces, demonstrating that it is possible to obtain a huge amount of data in little time. This is relevant because after an earthquake there is a limited window of time to record before demolition and other changes to the built environment take place.

Earthquakes have progressively destroyed Chilean-built heritage due to lack of maintenance and to the damage accumulated over the years, which makes the country particularly vulnerable to the effects of natural disasters. Heritage buildings have not only suffered earthquakes, but also inadequate reconstruction strategies. The social housing policies implemented for reconstruction are unable to cover whole historic areas and to improve the conditions of buildings in case of new seismic events. A good example is San Lorenzo de Tarapacá, a heritage village located in the north of Chile. Its buildings date back to the eighteenth century and

have been built using vernacular construction techniques such as *adobe* and *quincha*. In June 2005, the area was affected by an earthquake of 7.9 on the Richter scale, and it is still possible to see damaged and ruined buildings today, despite the different reconstruction processes undertaken both privately and by the state.

In such a context, the record of buildings before and after earthquakes, as well as before demolition, plays a crucial role (Devilat and Gage 2014). In post-earthquake situations, the technical assessment of historic buildings and dwellings is often done too late, when things have already been changed, not only by the earthquake but also by first emergency actions. Sometimes the only way to measure the level of damage caused is through previous records, which,

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although partial, can help professionals and researchers to evaluate the impact of the earthquake. In this context of constant change, accurate recording technologies such as 3D scanning can play an important role in the design of reconstruction projects. Shaw and Trossell support the use of such pioneering tools, where “the capacity for speculation and experimentation are equally as likely to aid design, to provoke moments of delight and provide commentary on the potential architectures of the future” (2011: 69). This is being explored in my current PhD thesis, entitled “Re-Construction and Record: Exploring alternatives for heritage areas after earthquakes in Chile”. The application of this tool has been used before in post-earthquake assessment, but it has not yet been employed to question the nature of the reconstruction, one of the main purposes of the present research.

The images below show a record done in January 2013 using a 3D terrestrial laser scanner (LIDAR). This technology is capable of capturing a 3D model of any built environment. Measurements are taken with a laser and colour is obtained through photographs.

The result is a very precise 3D model formed by millions of coloured points, which can be edited, sectioned and used as a basis for assessment and further design. Distortions, cracks and other effects can be easily identified using this technology. Furthermore, it is a three-dimensional representation of the state of a place at a given moment in time, which allows us to virtually transport ourselves to that place and study it. As such, this technology may prove a very powerful tool for post-earthquake intervention and reconstruction, especially in a seismic country like Chile. During three days, two persons scanned the heritage area of San Lorenzo de Tarapacá (its streets, as well as some interior spaces). This experience shows that it is possible to obtain a large amount of data in a short period of time, an important observation considering that, after an earthquake, there is a limited window of opportunity to record the state of a place before it is demolished or before other changes occur.

Figure 1, showing the 3D digital model from above, was created by compiling 178 scans of the village. Although the scans were taken from the ground level, the 3D

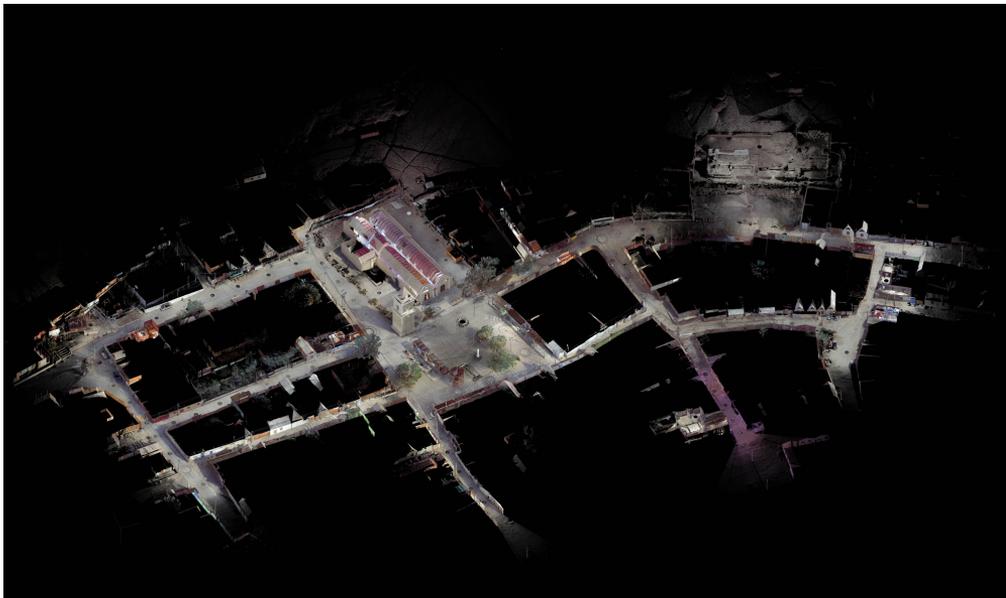


Figure 1: Virtual reconstruction.

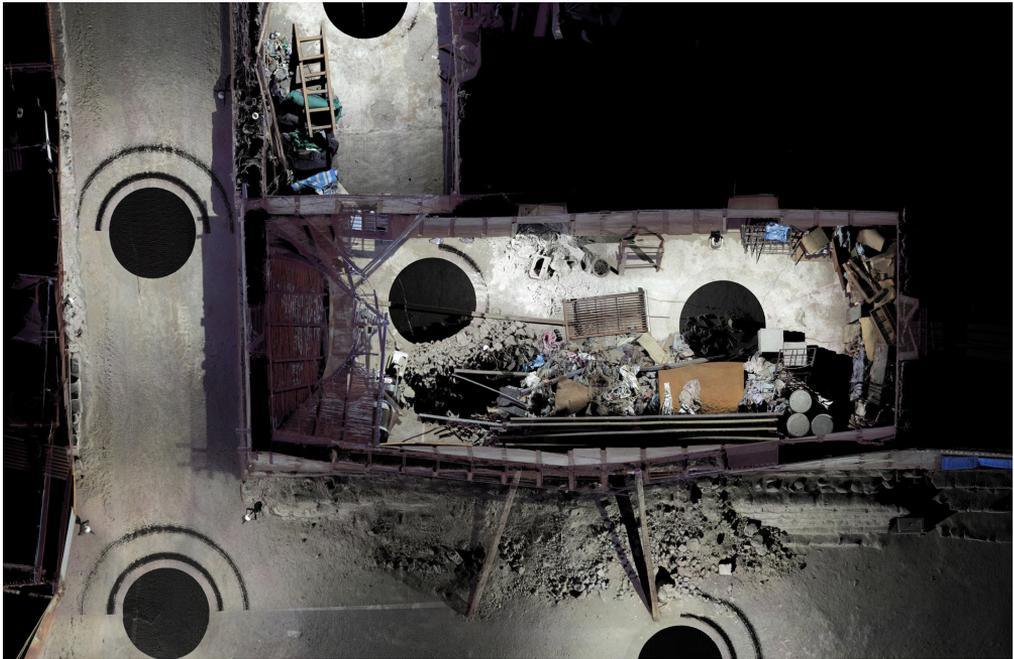


Figure 2: Recording ruins.

data gathered allowed us to reconstruct an image from above and get an insight into the layout of the historic area. Here, the idea of 'virtual reconstruction' is apprehended from two perspectives: on the one hand, a digital record constructed through assemblage of 178 independent scans; and on the other hand, the fact that it was still possible to see dwellings in ruins eight years after the earthquake, even though the reconstruction was officially over. Such reconstruction is considered virtual because a lot remains to be done to consolidate the historic village.

Figure 2 shows a top view of a dwelling in San Lorenzo de Tarapacá, which was affected by the 2005 earthquake and was still in ruins at the time of the survey in 2013. It is still possible to see and measure cracks and deformations from the 3D record. The roof was destroyed, thus allowing us to explore the inside of this historic house. The information obtained is a unique record of earthquake ruins and damages, which shows a high level of precision and can be converted into physical models using a 3D printer.

Figure 3 shows a plan view of San Lorenzo's church. After the 2005 earthquake, the previous church was severely damaged, almost completely demolished and replaced a few years later by this new building, which has almost the same morphology as the previous one. Since scans were taken both from inside and outside the church, the walls appear as black voids. The reason is that 3D laser scanning only captures surface information.

If we zoom into these images, we can see how accurate and detailed the data obtained by 3D laser scanning technology can be. This data may be used for several purposes during reconstruction processes, ranging from repairing and demolition, to intervention and replica. It also offers a specific representation of a place at a given moment in time—in this case, January 2013. Considering that other earthquakes have affected the area since then, it is important to think about the role that this record might play in the future, an aspect which my current PhD thesis proposes to explore further.



Figure 3: Reconstructed church.

Acknowledgements

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Notes

¹ A video showing the 3D scanned record of this village is available here: <https://vimeo.com/90651206>

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