SMALL TOWNS AND DIGITAL SURVEY: VIRTUALIZING CASTELVECCHIO CALVISIO, ABRUZZO, ITALY

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ABSTRACT

In the present a correct use of the available tools for digital survey may allow a fast and reliable documentation of architecture and urban settlement. The contribution to knowledge and to the quality of any intervention coming from the creation of a "digital twin" of the real is evident and when it is applied without appropriate accuracy is always a matter of missing skills and appropriate learning from the group involved in the intervention. For this reason, teaching and implementing digital survey at any scale when teaching about architecture is an important step: it allows to get a better control over any subject and it gives a clear and accurate documentation of the place before any following transformation. The case study of "Castelvecchio Calvisio" is developed in the logic of teaching and experimenting a practical, efficient, and useful approach to digital survey. It was operated in two workshops/summer schools in 2020 and 2021, with the will to share with the students all the methodologies and a skilful method of survey. The present article is a detailed report of the operations brought on during the first step, taken in July 2020.

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Non sai cosa sia e cosa contenga.
Vedi case, senti parole, silenzi,
in ogni modo resti fuori,
perché il paese si è arrotolato in un suo sfinimento
come tutte le cose che stanno al mondo,
ciascuna aliena allo sfinimento altrui.

You don't know what it is and what it contains.
you see houses, you hear words, silences,
you stay out anyway,
because the country has rolled up in its exhaustion
like all things in the world,
each of them is alien to the exhaustion of others.

Franco Arminio

Introduction

Castelvecchio Calvisio is one of the thousands of small towns in Italy, it has its specific aspects, its high-quality buildings, it is the product of a rich and complex history passing through centuries and leaving traces in the architectures, in their masonry and the various artefacts. The articulated situation of the small towns in Italy is subject to many different approaches, it can be well and shortly resumed in the words by Antonio De Rossi: “In recent years, Italy has often been represented as a nation with an urban structure closely linked to the size of major cities. but Italy is littered with “margin territories”: from the complex system of alpine valleys and mountains to the varied territories of the Apennine ridge, and gradually descending the peninsula until it encounters all those areas that classical southernism had indicated as "the bone" to be contrasted with the "pulp" until it reached the areas of the two large Mediterranean islands. These are the spaces in which human settlement has experienced old and new contractions; where the housing heritage is affected by increasing phenomena of abandonment; where the exercise of citizenship is more difficult, where inequalities and hardships are most concentrated. Adding them all up, these areas - “inland”, “fragile”, “shrinking”, “margin”- are home to almost a quarter of the nation's total population. These settlements are therefore substantial and could be the subject of a major “national issue”. On the contrary, other formulae seem to prevail in the context of smaller centres: the south, which is still lagging in development; the 'industrial triangle' of Fordist modernization; and the 'Third Italy' of the districts. In the centre, the bulky presence of the metropolitan dimension, able to obfuscate, almost to the point of turning

it off, "everything else". Today, the specificities, vitalities, opportunities and public and collective actions of this rest are once again visible. Showing a potential that could animate a new reading of the country." (De Rossi, 2018).
Any approach to this system of settlements should start from an integrated qualitative and quantitative method, on one side the knowledge and the capacity of comparing the information from different environments may give an appropriate understanding of the value of the place, making it possible to operate using "site-specific" interventions, capable to valorize the local aspects, avoiding the flattening of the places to generic, unpleasant (and then often unsuccessful) models merely based on repetitive rules. On the other side, the correct documentation and the accurate survey of the urban areas -especially in an age of easy data management and transmission- may allow the definition of accurate and efficient proposal strategies, based on a correct knowledge of size, extension and spatial relationships of the urban and architectural assets, having the perfect base for operations aimed to the protection and the renewal of the built heritage and its urban context in terms of cultural preservation, safety, energy efficiency and accessibility.
Interventions based on academic workshops and digital surveys can be a well-working starting approach, they offer understanding and knowledge of the places, accurate reading and interpretation of the values, potential cultural growth of the participants. Moreover, the digital interventions done during the workshops create "digital twins" of the areas that fix the state of a place in a very narrow lapse of time, creating easy to share and valuable documentation for present and future uses.

Castelvecchio Calvisio: essential storyline
Castelvecchio Calvisio lies on a hill that rises to the South of the vast plateau of Campo Imperatore. It is settled 1067 meters above sea level, it has always been at the centre of disputes due to its strategic position. The first news about the village dates back to the time of the fall of the Roman Empire when it assumed shape and identity with the foundations of its original development (Morico, 2004). Originally a series of "villas" (later districts) formed a small rural agglomeration dating about the VIII century and characterized by the presence of four churches: St. Lorenzo, St. Giovanni, St. Martino and St. Cipriano. The latter was a parish church and immediately remained isolated from the others (Crisan et al., 2015). With the advent of feudalism, many small rural realities felt the need to take refuge in a fortified place that

would give them better security from possible raids (Rankin and Abrahams, 2010). After the dominion of the Counts of the Marsi, it was the turn of the Acquaviva family to control the ancient village until the early years of the XIV century when Corrado I became Lord of Castelvecchio. The town had various disputes with Barisciano, a neighbouring settlement, they mostly regarded the possession of the mountains of Campo Imperatore, such troublesome conditions kept on until the end of the century. The village was then ruled by Charles III from Durazzo, then by the Counts of Celano and later by the Sforza family. In 1423, Braccio da Montone managed to sack and destroy Castelvecchio, employing large forces to win the resistance of the inhabitants. Almost twenty years after the beginning of the sixteenth century, the Barony of Carapelle, which also included Castelvecchio, passed to Antonio Piccolomini, Duke of Amalfi and Count of Celano. In 1556 Costanza Piccolomini sold both the feudal domains and the Marquisate of Capestrano to the Grand Duchy of Tuscany, Francesco dei Medici. The dominion of this family lasted throughout the XVII century, giving a long period of peace and prosperity. The economy of Castelvecchio was based on agriculture for subsistence purposes and the cultivation of saffron. At the same time, it was part of one of the most important pastoral basins in Italy, controlling the commercial traffic along with the Via Degli Abruzzi: an ancient itinerary that connected L'Aquila, Florence and Naples allowing the pathways of the flocks of sheeps. In the XVIII century, the Barony of Carapelle passed under the dominion of the Bourbons, annexing the Abruzzo lands to the Kingdom of the Two Sicilies. Castelvecchio reached its municipal autonomy from Carapelle in 1906. The characteristic ellipsoidal shape, easily legible from the walls that contain the ancient village, follows the natural slopes of the hill. From the "spina decumanica", the axis following the "decumano", a part of the roman centuriation (Dilke, 1971) that runs through the elliptical structure from North-West to South-East, seven crosspieces branch off perpendicularly to the North and eight to the South. The presence of the Roman urban structure should not surprise, while it is common in most of the settlement created or reorganized during the Roman ages (Strappa et al., 2015). The houses are developed on several levels which are connected to the street level thanks to steep stairs that rest on round arches or characteristic stone shelves, the so-called "barbacani". This was an architectural solution that allowed the exploitation of the cramped space of the alleys dividing the level of the street, where the artisan shops were located, from the upper

residential floor. The built space is then organized according to a regular geometric arrangement where in some cases secondary passages and arches are required to connect the parts. The village is configured as a real defensive fortress, equipped with house-walls that follow the elliptical shape and have overhanging bodies in a cadenced manner with the function of guard towers for flanking shooting. The parish church of St. Giovanni Battista, which was incorporated into the walls through a subsequent expansion due to the need for additional space for the population, appeared to be a fortified building, this is evidenced by the presence of loopholes. Originally the medieval nucleus was accessed from the outside through four passages that could be closed for defence: Porta di Torre Maggiore to the West, of the door to the South only one jamb remains, Porta di San Martino is placed to the South, Porta del Ponte is placed to the North-West surmounted by a decorative stone, now in poor conditions. Right under the Palazzo del Capitano at the gates of the village, there remains the trace of a moat that in the past was presumably crossed through by a drawbridge.
The regular and ancient organization of Castelvecchio was followed by a completely disordered expansion of the town outside the walls, both along the communication routes and to the South on the side of the hill. The ancient village still enjoys a suggestive South-East view towards the Tirino Valley while it remains visually connected from North to South with the medieval castle of Rocca Calascio, Calascio, Santo Stefano di Sessanio and Carapelle Calvisio.
Currently, the original village records a strong state of neglect given the damage caused by the seismic events of recent years. The earthquake of 2009 afflicted about 40% of the buildings, making them unusable, forcing the inhabitants, mostly elderly, to leave their homes. Many buildings received emergency intervention to make them safe, allowing the reopening of some cross streets while others are still not viable today due to the presence of structures that are in disrepair and increasingly unsafe over time. Walking through the village and along the main road axis, it is possible to have "suggestive" views torn apart by the earthquake and time: the long state of abandonment and the lack of recovery interventions have aggravated the state of decay which is causing the collapse, total or partial, of roofing and attics.

Digital survey: strategy
The digital survey of Castelvecchio got its base from the logic of the workshop. It is not an intervention aimed to document the specific decay of a building or to go in depth with a

single aspect or monument. It is a general recognition of the whole downtown between "the walls" oriented to create a complete digital twin as a base of knowledge, which means creating a proper set of information for the participants of the workshop, allowing at the same time them to take part to the survey operations with a rapid sharing of the contents for reading and processing. With these intentions the time factor is fundamental, making the whole work fitting the calendar requirements becomes a fundamental step. In the time of ten days the participants should move from the first approach to the place to an intervention proposal based on a proper survey. The option about taking the survey before the start of the workshop and then making it ready on the first days, should be an option, but the involvement of a skilled team, efficient instruments and the challenging situation may result in a very positive experience. Furthermore, in a "normal" workshop the participants may experience directly the use of digital survey tools, in a lot of cases it may be the first time they have the opportunity to put "the hands-on" a 3D laser scanner or seeing a professional use of a drone/UAV unit for built heritage documentation. But in July 2020, during the ongoing pandemic event, with the workshop moved online, with all the participants following the activities from their homes, the possibility of using the digital survey activity as a link between people was an extra feature enriching the general situation. In that period, in Italy, the pandemic conditions were such to allow the free circulation between regions and so a small team of three people moved from Florence to Castelvecchio for a three days survey activity aimed to produce a complete documentation in support of the workshop.

The structure of the operations was optimized for having the maximum coverage in the available time: a classic solution, based on lasergrammetry from the ground level and aerial photogrammetry for all the top parts and the main fronts

Figure 1 - The 3D laser scanner unit at work and first in place data treatment with importing and alignment in Autodesk Recap (© S. Giraudeau, G. Verdiani, A. Leonardi).

of the extended perimeter looked like the optimal solution for such a task. The lasergrammetry operations would give the coverage of all the street and narrow alleys while the photogrammetry from the UAV unit would have produced a complete map of the roofs and all the perimetral fronts, reducing the need for at least one more day of scanning operations along the edge of the downtown.

Figure 2 - View of the aligned point clouds in Autodesk Recap (© S. Giraudeau, G. Verdiani, A. Leonardi).

Figure 3 - All the aligned point clouds from the lasergrammetry in an orthographic view (© S. Giraudeau, G. Verdiani, A. Leonardi).

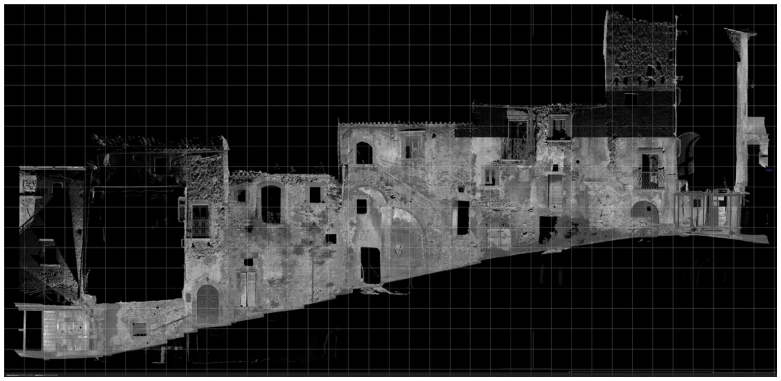

Figure 4 - A front extracted from the aligned point clouds in orthographic view (© S. Giraudeau, G. Verdiani, A. Leonardi).

Digital survey: lasergrammetry

The operations based on the use of a 3D laser scanner unit were the backbone of the downtown digital survey, the instrument was a Zoller+Fröhlich Imager 5016, using phase-shift laser technology to take measurements with an operative range of 180 metres on each side the possibility to take full panoramic scans on 360° on the vertical axis and 320° on the horizontal axis, covering a whole "dome" all around the scanning station.

The scanner is equipped with a GPS unit that allows an enhanced accuracy in the positioning of the scanstation when it works in open spaces. The good speed and the high accuracy (about two millimetres at a distance of 10 metres on standard reflective elements) together with the acquisition speed, capable of reaching up to about one million points per second, made it possible to cover very large areas with a high level of details and short scanning time. The density of the points captured by the 3D laser scanner defines the level of details of the resulting point cloud and together with the overlapping ratio will make it possible to align all the scans together in automatic or manual mode. The resolutions used for the documenting in Castelvecchio were set up at "medium" or "high" values in most of the situations, which means, in the case of "medium density", producing point clouds with a point hit every centimetre at a distance of ten meters, optimal for almost all interiors and narrow streets/passages, while in case of "high density" there will be a point every six millimetres at ten meters distance. These densities were associated with the "quality" parameter, in the case of small spaces and low light, it was set on "middle" which means interpolation of three consecutive measurements on the same point (bringing a duration of each scan of one minute and thirty seconds at a medium density and of three minutes at high density), in case of large spaces and/or bright/direct sunlight the quality was set on "high", which means an interpolation of five consecutive measurements on the same point (taking three minutes at medium resolution and of six minutes at high resolution). In general, each scan station took from five to fifteen minutes from the positioning to the completion of the scanning operation according to the complexity of the specific scan (accessing areas, climbing stairs, removing some fragments from the ground, changing the batteries, moving around the town in between two different scanning sequences, may require longer times).

All scans, in their final version, contained between 22.000.000 and 5.000.000 points, based on the scanning resolution and the actual extension of surfaces. In all operations, no specific

targets were used to facilitate the subsequent alignment process of the entire set of scans the presence of wall surfaces rich in details, the morphology characterized by large openings and narrow spaces, however with high and vaulted upperparts and rich in signs, stains and elements designed to facilitate alignment by geometric comparison, have made it possible to obviate the application of flat or spherical targets, significantly accelerating the procedure of operations. With an overall number of 337 scans, all the originally planned intervention areas were completely covered.

Digital survey: photogrammetry

In recent years, photogrammetry has made significant progress in terms of technology and functionality, it has undergone significant "popularization" (Rodriguez, 2012), but has also made the "pick-up and return" procedures easier and more immediate. The last 10 years brought an impressive evolution of the photogrammetry software, making the passages based on Structure from Motion and Image Matching (SfM/IM) extremely accessible for many different kinds of photographers. At the same time, the quality increment in all the digital cameras helped a lot in the production of high-quality results from almost any recent photographic tools. In addition to this, the extremely incremented accessibility to "flying cameras" made instruments such as drones an effective role in supporting the survey. The significant versatility and potential of a drone are evident thanks to the ability to access a previously unimaginable position and the automation of shooting processes (Rodriguez et al., 2018). Thanks to the small size drones are tools that can be easily transported in many contexts, from the urban to the human/natural landscape.

It is possible to divide drones into two macro-categories: the composite, which can mount compact cameras (with variable zoom) or even reflex or mirrorless cameras (which allows changing optics adopting the camera to specific shooting needs), and the "standard", created by manufacturers, they have standard cameras and are therefore not replaceable and with a single lens, often offering a wide-angle field of view. On the one hand, if the quality of the cameras and sensors on all types of drones keep on improving, from medium to professional ranges, on the other hand, there is the possibility to clash with the weight of the aircraft, which often goes hand in hand with the size of the mounted camera.

The Italian and European legislation on the use of UAV (Unmanned Aerial Vehicle) is very strict and limits the use of drones according to their weight and the context in which

they are used. Without going into the regulations, to fly a drone of a certain weight, except that you have a flying license and insurance, you must apply for special permits issued by ENAC and ENAV, air traffic control bodies (ENAC, 2019). To facilitate the solution of this problem, you can opt for lighter drones, with less restrictive regulations, which may, however, have less performing cameras.
In this case, it is necessary to make a choice at the beginning about the real possibilities of flight and the final result we want to obtain from a survey, or more simply how much time we are willing to spend on the bureaucratic aspects of issuing to resolve a permit. In fact, waiting times of up to two months are achieved, which often do not match the timing of the surveys, which may require shorter times.
In view of all these parameters to be taken into account, a drone (Fig. 5) lightweight up to 300gr was used for the recording of Castelvecchio Calvisio. to be able to work in urban contexts with non-critical operations, as required by Italian aviation regulations.
The cameras mounted on drones usually have three methods of storing files: JPEG (i.e. a format subject to 'destructive' compression, with dimensions when stored in the order of 5/8 Mb), RAW and RAW + JPEG. Unlike a high-quality reflex camera or a compact camera, there is no possibility to choose different types of JPEGs (low quality, medium quality, high quality). This implies the need to have complete information that the sensor can record, shooting always in RAW and even better in RAW+JPEG to always have a lighter copy of the image at hand, therefore easy to manage. As it is for the photogrammetry from the ground up, it may be possible to have issues in archiving and then processing large and large amount of images.

Figure 5. Parrot Anafi. Drone used for the Castelvecchio Calvisio mission. Wide-angle f/2.4 ASPH lens, 35 mm equivalent focal length: 23-69 mm (sensor set in photo shooting mode), 26-78 mm (sensor set in video shooting mode) (© S. Giraudeau, Y. A. Mazurek).

The JPEG files, which were originally compressed and developed from the DNG file, differ significantly, although they have the same size of 5344x4016 pixels. In the first case, the drone develops an image with a weight of about 6 Mb, pleasing to the eye and low contrast (shooting mode in P-Log), which, however, if magnified, is thoroughly an effect that is certainly implemented by the anti-aliasing filter, and in which the outlines of the subjects being shot may be less sharp and vague. In our study (Fig. 6) the magnification is increased to 400%, which makes the defect noticeable. In the second case, the JPEG developed by DNG, weighing about 18 Mb, did not undergo any post-production, to avoid tampering with the exif data for the correct reading of the photogrammetry software. The image is more contrasted and perhaps loses something in the details in the dark parts. However, the outlines of the painted subjects are clear and well defined; you can see this especially in this example of the quality of the roofs of the buildings and the texture of the paving stones (magnification up to 200%).

Castelvecchio Calvisio: Aerial photogrammetry

For recording by aerial photogrammetry of the city of Castelvecchio Calvisio, there were two flight options: hand fly and photographic shots selected by the pilot, or a planned flight mission, with a series of photos taken automatically. In the first case, the available time (two days) to perform the aerial survey would not have been sufficient. Consequently, the choice went for the use of automated flight software.

The mission planning and management software allows the pilot to fly the automatic guided drone to cover areas, setting the surface to be covered, the overlapping percentage of the images and the tilt of the camera. However, this mission planning software, which helps and facilitates the recording

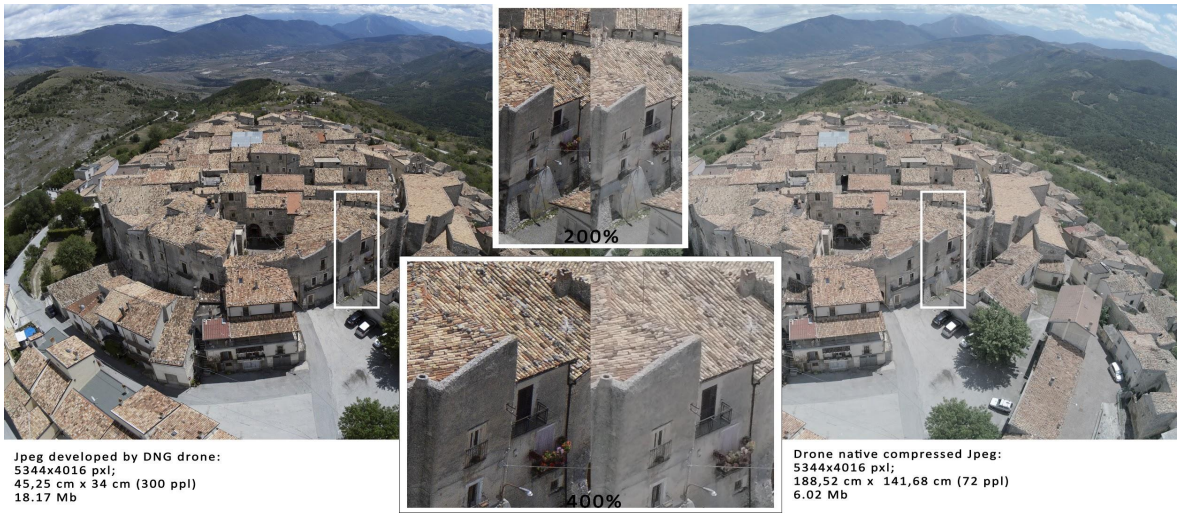

Figure 6. Comparison of the two types of JPEG files from the drone. Aerial view of Castelvecchio Calvisio, July 2020 (© S. Giraudeau).

activity, often does not support the storage of the raw file on the memory card installed on the drone, but only saves the photographed material in JPEG format.
In this case, there is the need to make an assessment: have a fast flight time easily and automatically, but collect data of lower quality, because it is only obtained in JPEG, or perform the recording by manually the drone management, with longer times and a personal evaluation of the percentage of overlap of the photos, but to store the photos taken in raw, and thus have a higher quality data.
The land survey was conducted with the planning of five consecutive flight missions (Fig. 3) to achieve the total coverage of the area to be investigated. Each mission covered an area defined by a rectangle of 55 meters by 200 meters. The UAV was used only for taking pictures from the top, it was not possible to make the drone fly through the streets of the town due to the narrow space that would not have allowed safe maneuvers of the unit.
For each rectangle, the drone followed a path through a double perpendicular grid. The average duration of each flight was 14 minutes. A total of 609 JPEG images were taken (Fig. 7).
The flight parameters set for all five missions were the same to maintain homogeneity in the survey. The overlap of the images taken is always set at 70% to have a high overlap. The inclination of the camera is set at 80°. The speed of the drone is set to medium-low to prevent the shot from suffering the effects of shaking, as the drone in this type of flight does not stop floating to take every photo, but keep on moving as it

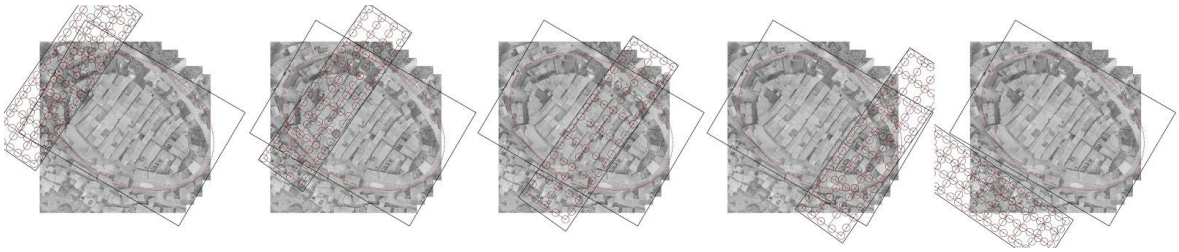

Fig.7 Sequence of flight schedules (© Trimboli, Mercurio). Castelvecchio Calvisio, Abruzzo, Italy. Survey for the Ozyegin University workshop, July 2020.

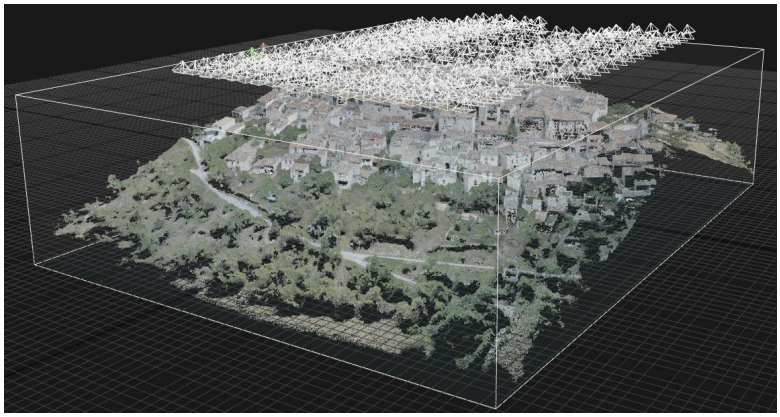

Fig.8 Screenshot of the 3D model, Reality Capture (© Giraudeau, Leonardi, Verdiani). Castelvecchio Calvisio, Abruzzo, Italy. Survey for Ozyegin University workshop, July 2020.

shots. With the low speed, it is possible to set a low ISO value avoiding excessive image noise grains. In the end, among the parameters set, there is the flight altitude of the drone; in this case, it flew 30 meters above the ground; this height allowed a yield of one cm for one real pixel from the 21Mp Sony 1/2.4" CMOS sensor.
The photogrammetric aerial view covered the entire part of the roofs, not accessible for the recording made with the 3D laser scanner. It is therefore possible to integrate the point cloud of the scanner with that of the photogrammetry to have a completely merged dataset.
It was decided not to make a photogrammetry campaign from the ground as this was impossible due to lack of time.

Data processing and workflow - Analysis of the material produced on site and error solving:
If the final calculation of the 3D model was performed at a later time with sufficient hardware to process the data, especially thanks to the support of the LIA, Computer Science Laboratory of the Department of Architecture in Florence, it should be pointed out that during the survey phase, Once the aerial photogrammetry data has been collected, the 3D model (via Agisoft Metashape software) is still processed at low quality on a laptop to check that the collected data is sufficient and that there is no risk of information is not missing. In that case, the aerial survey team would be able to

Figure 9. 3D model orthophotos, developed in Agisoft Metashape (© S. Giraudeau, A. Leonardi, G. Verdiani).

gather other data necessary for the completion of the survey. In addition, the orthophotos generated by the 3D model developed on site were used to develop the plans and sections needed for the purpose of the workshop itself (Fig. 9).The result obtained by the model processed with the maximum quality (parameters become maximum for each calculation step), is quite satisfactory. The alignment of the photos is 100% and the fact that working with compressed data such as a JPEG image (in the order of 5/7 MB for each photo) did not lower the final quality of the work. The model consists of 35.389.799 faces and 17.727.890 vertices.
It is interesting to see from the result of the 3D model (Fig. 10), (Fig. 11) how the slope of the hill is perfectly defined and that the perception of the height difference between the upper part of the city and the lower part is modelled. This allows for a positive evaluation of the use of a small drone, like the one used in this survey, to detect large urban or suburban contexts.

Post-processing of the data and development perspectives
The main processing applied to the data gathered during the digital survey was the alignment of the lasergrammetry and the processing of the photogrammetry, all the results (images, vectors, short movies) were shared with the participants to the workshop, creating a common base on which develop the

Figure 10. Aerial survey result, developed with Agisoft Metashape; 35.389.799 Faces; 17.727.890 Vertices (© S. Giraudeau, A. Leonardi, G. Verdiani).

Figure 11. Aerial survey result, developed with Agisoft Metashape; 35.389.799 Faces; 17.727.890 Vertices (© S. Giraudeau, A. Leonardi, G. Verdiani).

various intervention and reuse hypothesis. The digital twin of Castelvecchio Calvisio is now a perfect reference base of knowledge about the condition of this valuable town as it was in July 2020, in a situation still offering an interesting option for recovering thus with many parts suffering hard neglect issues. The further steps should be the merging of the photogrammetry to the lasergrammetry for producing a single digital model, thus this feature at the moment is not that appealing while both the surveys are well aligned on the same GPS coordinates and give different and useful information that can be used according to needs using a "lighter" version of the whole town. In the future, according to specific conditions it will be of interest to extend the area covered by lasergrammetry, including the quarters around the downtown and integrate some of the main buildings and some sample of house typology with their interiors to have a more complete description of the features of the place with its local architecture. On the front of the photogrammetry, some new UAV shooting may be planned to integrate the previous and check the ongoing state of decay of the roofs, one of the main risks in keeping the integrity of the houses. Some photogrammetry from the ground may be coordinated with the intervention on the interiors to sample specific buildings with a complete and accurate documentation for interpretation, maintenance and restoration aims. The development of a surface model should be planned, a solution based on parametric modelling should be a good base for having an essential reference for a light H-BIM or GIS management of the state of decay and restoration/recovery of the building units.

Conclusions

Natural disaster, decay, abandon, inactivity in the interventions, economic difficulties and in the end a pandemic event seem all to work against a possible recover of Castelvecchio Calvisio, it is true that the town, entering a slow decay phase immediately after the earthquake has somehow gained a specific melancholic fascination on visitors, but it is something that on the long run will bring only to the loss of valuable part of the town (Marulli, 2010), the gradual recovery of the buildings, where ongoing, sometimes appears misaligned to the original value and quality of the place: replacing hardly damaged buildings with "squares" or open spaces damage the image of "density" of the fortified town, appearing like a hole in the armour of a turtle. So, understanding the built heritage is not playing with it using all the possible or the cheaper solutions, it is to keep the important aspects and make them count in the

preservation of the place. A digital survey like the one done in July 2020 is a perfect base and allows to manage easily the contents of the whole settlement, allowing a quick look to any operator and giving the possibility to inspect any part in detail according to a specific need. The approach to such a situation with academic workshops is for sure a relevant and efficient way to obtain some step forward in the recovery and revitalization of very difficult conditions, with the hope to be soon ready in bringing the students back in the places out of the present pandemic emergency.

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