

## INTRODUCING EDM SURVEY FOR RECORDING VERNACULAR HERITAGE AND SITES IN PAKISTAN

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### ABSTRACT:

The case study of 200 years old *Khaplu* Palace will present the outcomes and issues of recording of an outstanding example of vernacular monument with EDM device and related software for the first time in a very remote and mountainous area of Pakistan.

Heritage conservation in Pakistan has always been facing lack of resources and expertise and is accorded low priority. Recording heritage, one of the most important prerequisites in conservation, is not addressed properly. Conventional methods for heritage documentation are in practice but have their own limitations and consume a lot of time and resources and result in technical errors. Also the architectural schools in the country have no exposure and training programmes for their students in heritage recording.

Since 1991 AKCSP is actively involved in monument conservation in Northern Areas of Pakistan with the active participation of local people. Conservation of 700 years old *Baltit* Fort and 400 years old *Shigar* Fort are the prime examples in this regard. During these projects on-site trainings of architects and engineers and summer internships were offered to the students from architectural schools which also enhanced the exposure of conservation primarily, and secondly, architectural survey as a basic step.

Since 2005, on site training programmes in EDM building and topographical surveys have been organised for local girls and boys in order to build the local capacity. Initially trained girls are now part of Women Social Enterprise (WSE) formed by AKCSP and working full time as an enterprise on topographical surveys in Northern Pakistan. A team of architects and engineers were also provided opportunities to extend their skills in architectural surveys while working on historic 200 years old *Khaplu* Palace and Wazir Khan Mosque Lahore and the topographical survey of the Walled City of Lahore.



Fig. 1. 3D wire-frame model of *Khaplu* Palace Complex. Hundred years old historic agricultural walls and buildings documented using measured drawing technique, EDM (total station) survey and rectified photography. This drawing is an AutoCAD drawing developed from 3D wire-frame.

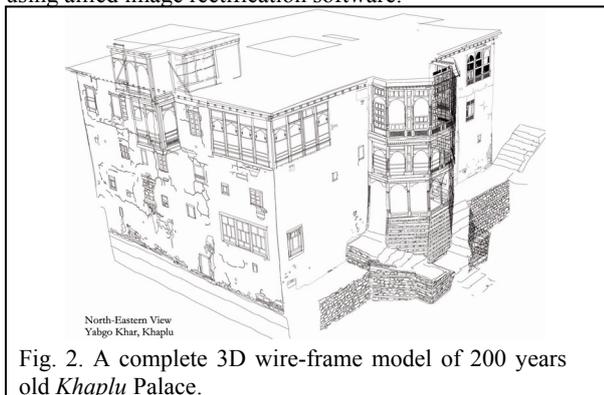
### 1. INTRODUCTION

The conservation of 700 years old *Baltit* Fort in *Hunza* by Aga Khan Cultural Service Pakistan (AKCSP is the Pakistani arm of Geneva based Aga Khan Trust for Culture of its Historic Cities Programme) demonstrated a strong regional

innovative model of heritage conservation, long term sustainability and its use for local development. It also presented the concept of architectural documentation for practical conservation in Pakistan. The conventional manual documentation practiced was later applied on other AKCSP projects in Northern Areas of Pakistan. All these vernacular

monuments have no such previous records of drawings, images and iconographical sources.

The repercussions of rapid development had already been observed on the built heritage of this remote Northern Areas of Pakistan. The high quality conservation work dictated AKCSP to upgrade the conventional recording practices of monuments and order them in a systematic way. And in an area where the legislation regarding the protection and inventory of the monuments is not fully active, the documentation of vernacular monuments and settlements becomes an even more serious activity. Furthermore, international recognition in the form of UNESCO heritage awards of completed projects made AKCSP realize the process of documentation as a specialized field. This was the time when AKCSP had just finished the conservation of 400 years old *Shigar* Fort and initiated the ground work for the conservation of 200 years old *Khaplu* Palace in *Baltistan*. In a way all the previous projects were following the international guidelines for conservation but the more specific guidelines (Article 16, Venice Charter) related to precise recording and reinterpretation of monuments were slow to receive attention. Pursuing an advanced master's studies in architectural conservation at Leuven, Belgium provided me a chance of getting the hands-on experience and exposures to recent practices in heritage conservation. REDM was one of the methods which I introduced for the first time in Pakistan for heritage documentation and 200 years old *Khaplu* Palace was the first surveyed monument with this method. This method was further strengthened by using allied image rectification software.



## 2. THE SURVEY AND PROJECT LOCATION

Located in the rugged Karakoram mountain range at the height of 2500 meters, the 200 years old *Khaplu* Palace is the finest surviving edifice of royal residence in *Baltistan*, Northern Areas. Its significance lies in its cultural importance as a former seat of royal government in the area, and in its quality as a building, both aesthetically and as an exemplar of traditional building typology with a lot of influences from neighbouring region (Kashmir, Ladakh, China, and central Asia). As part of a wider cultural heritage support programme in *Baltistan*, the long term sustainability is one of the prime objectives set by AKTC-AKCSP for this project. Working closely with the local community the project is contributing in reviving the traditional wooden and building crafts, income generation activities and capacity building of locals.

Site surveys and documentation prior to any conservation and restoration works are now defined as the basic pre-

requisite for understanding an historic building or site. This has been widely expressed in many national and international charters and conventions – from Athens Charter of 1933 to the Venice Charter of 1964 to Burra Charter. This discipline needs proper training, human resource and equipment. In the absence of any previous documentation efforts, the current documentation programme with EDM equipment was experimental in its own nature. Its main objectives being:

- Disseminate and build capacity in recording techniques with REDM.
- Gather the detailed information of a vernacular monument and site in the form of base drawings.
- Detail recording of the as-found state of the monument which ultimately allows us to propose conservation and re-use plans.
- Set an example of architectural survey which would be available for researchers and experts for future studies.
- After conservation, this documentation will provide us the basis for management, monitoring and maintenance of the site and monument.

In a remote situation where documentation of heritage faces huge challenges like the lack of experts, communication, dissemination and standard guidelines, the basic aim of this documentation campaign was to address the cited challenges. Documentation is a process which continues during the conservation of any monument and this is the only accurate tool to record the information for understanding the structure which ultimately leads to the management of a conservation plan.

The field survey, as a training process, was initiated in October 2005 primarily to cover the topographical features of this historic vernacular site. Initially the field data was gathered with one total station (Leica TCR 405) which was downloaded on a computer and then converted to vector form with the help of LisCAD and AutoCAD. The second and comprehensive stage of documentation of historic buildings was initiated in March 2006 with the aim to document the monuments for the practical conservation works. The parallel running conservation activities made this documentation campaign more challenging as we need to record the as-found state of the monument and site. Therefore, the more practical solutions were worked out to meet the time and conservation activities. The inevitable combination of EDM survey and rectified photography was practiced. A combination of a field laptop, TheoLT and AutoCAD software for real time survey and Trectify for image rectification purpose was practiced.



Fig. 3. North view of *Khaplu* Palace with main entrance wooden loggia under restoration

### 3. DRAWINGS AND INTERPRETATION

In this project EDM survey provided us an opportunity to interpret the obtained data in a variety of ways. Most of the team members knew the architectural documentation with conventional manual measurement and drawing method. The new EDM survey technique was never easy to understand therefore, initially it was very important for me to provide them common and easy examples. For this we initiated introductory lessons about the instruments and its future interpretation in form of drawings. In a remote environment this was not an easy job to do, therefore it was important for us to overcome the limitations of our survey with new technology. Soon the team realised that this technique reduced a substantial amount of time and labour in comparison to manual method and above all this is very precise and accurate.

The team also knew the problems with manual documentation methods. The inaccuracies in the manual documentation process, due to the manual sketches, manual measurements, and the conversion of manually drawn scaled drawings into vector drawing through a laborious scanning process, were easily mitigated with this combination of EDM and rectified photography surveys.

Since 2006 most of the architectural documentation has been completed in the form of floor plans, reflected ceiling plans, structural plans, detail elevations of each room, cross sectional drawings, building elevations and a complete 3D wire frame model. Most of the major elevations and elevation features in the cross sectional drawings were completed with the help of image rectification software combined with EDM survey. Rectified photography has been used to map the condition of external and internal elevations of the monument which was later converted into vector form.

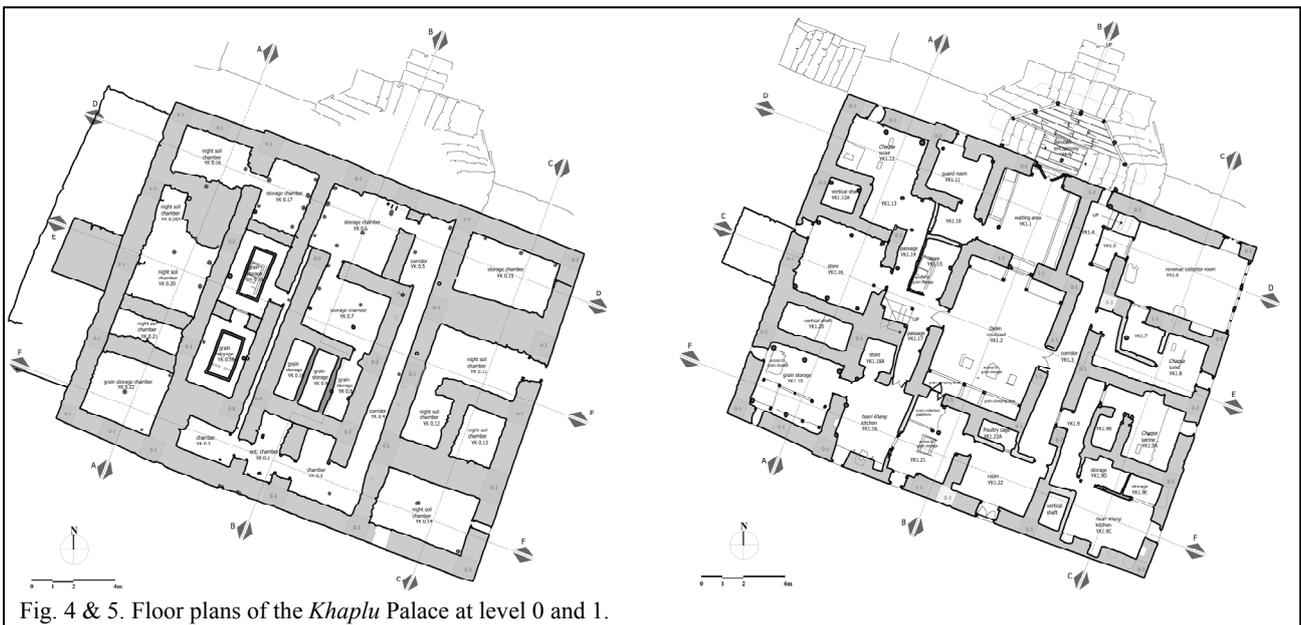


Fig. 4 & 5. Floor plans of the *Khaplu* Palace at level 0 and 1.



Fig. 6. Rectified photography of western elevation of 100 years old *Darbar Khang*

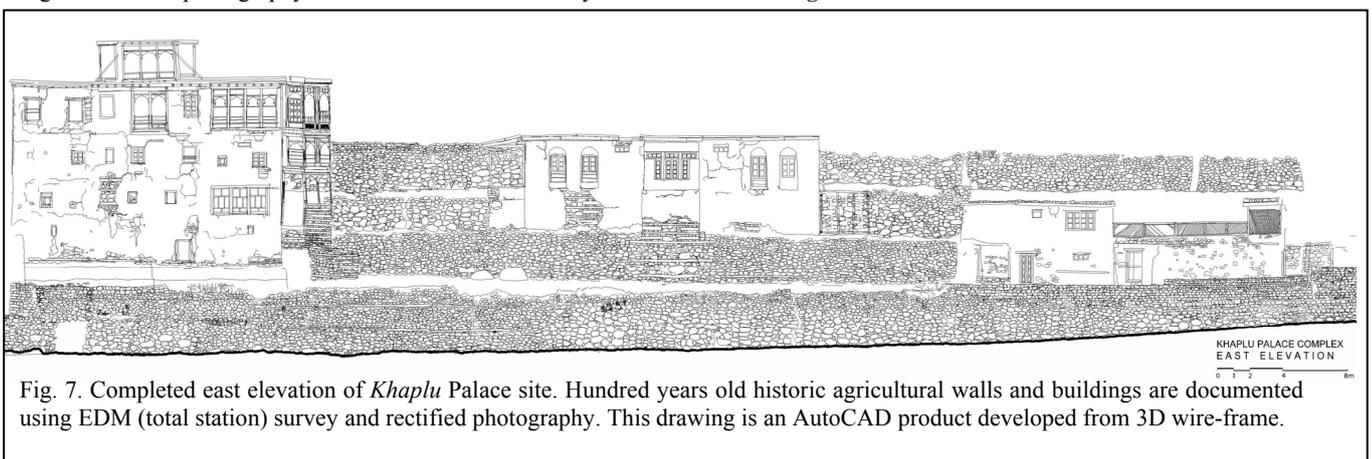


Fig. 7. Completed east elevation of *Khaplu* Palace site. Hundred years old historic agricultural walls and buildings are documented using EDM (total station) survey and rectified photography. This drawing is an AutoCAD product developed from 3D wire-frame.

#### 4. INVESTIGATIONS AND CONSERVATION OF MAIN ENTRANCE LOGGIA

Primarily, the data in form of CAD drawings produced with the help of EDM survey has been used to study the monument and its adaptation for reuse. Secondly, the data was key to identify and study the dilapidated parts of the monument. Total station has been extensively used during the investigations of the structure of the main entrance loggia of the palace. The abnormal tilt and the subsidence obtained from EDM survey of the loggia at the floor level of level 1

revealed that this part of loggia was not structurally connected with the main building of the palace. The investigations showed the tilt of 14 cm and subsidence of 8 cm in the structure. Based on other such structural connections in the palace, the intervention proposal was implemented. A new connection and additional wooden beams were proposed. In order to remove the tilt and subsidence in the structure, hydraulic jacks and turning buckles were used. The process of lifting and pulling back of structure to a satisfactory position was closely monitored with the help of total station and allied software.

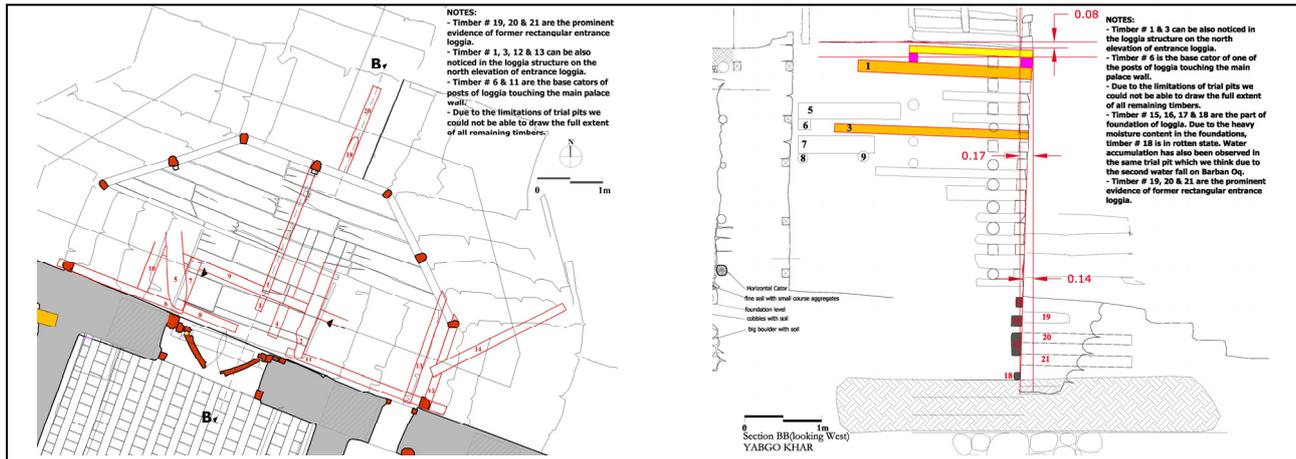


Fig. 8 & 9. Set of drawings produced for the restoration of wooden entrance loggia about 10 meters high. This set of drawings shows the structure and location of timber elements in the plan and section. Additionally, the sectional drawing shows the subsidence and bulge in the structure

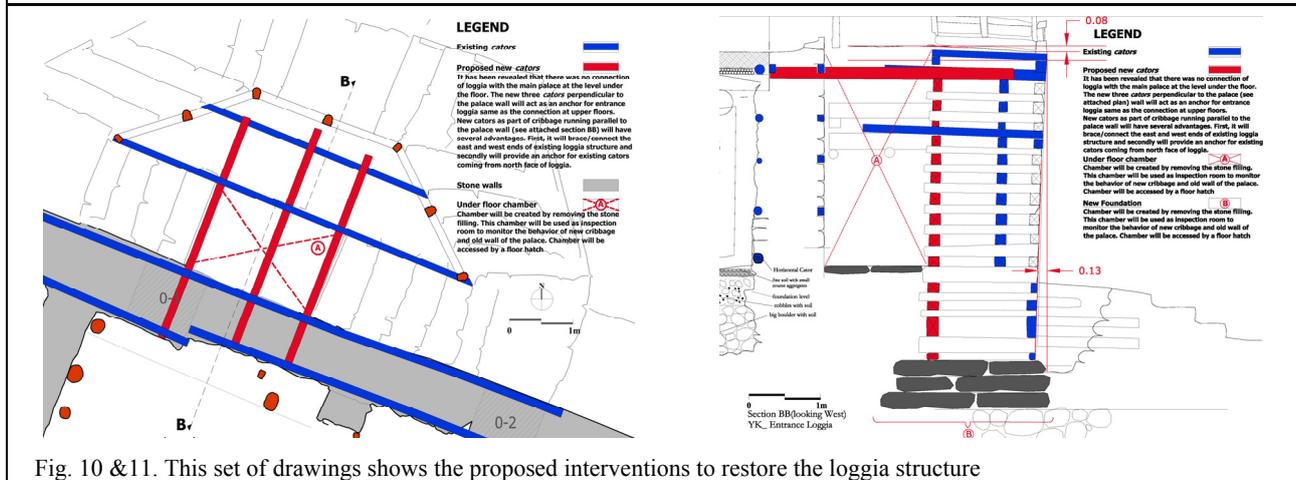


Fig. 10 & 11. This set of drawings shows the proposed interventions to restore the loggia structure



Fig. 12. Traditional construction techniques are being implemented during the restoration of loggia



Fig. 13. Lifting and pulling back the loggia to a stable state is being closely monitored with total station



Fig. 14. Lifting of loggia to a stable state with the help of hydraulic jacks



Fig. 15. Turning buckles are being used to pull back the tilted loggia

## 5. CONCLUSION

As part of dissemination, in the past three and half years, a total number of 25 people were trained in topographical survey with EDM technique. Additionally, 10 architect and engineers have also been trained in more advanced techniques of architectural building survey with EDM device and image rectification process. The process which was initiated on a vernacular monument in Northern Pakistan has now been actively practiced in the Walled City of Lahore documenting the thick urban fabric and historical monuments of great importance. It's been encouraging to see all this

progress, but there is still a long way to go in spreading and sharing this knowledge with other actors in the field.

In the context of Pakistan, the rate of uncontrolled development and the lack of updated technologies and expertise are the main causes of heritage loss and the main hindrance in documentation. In this situation the concern authorities for cultural heritage should least start updating the documentation process of deteriorated monuments in more accurate and timely manner by utilising the best practices of EDM survey.

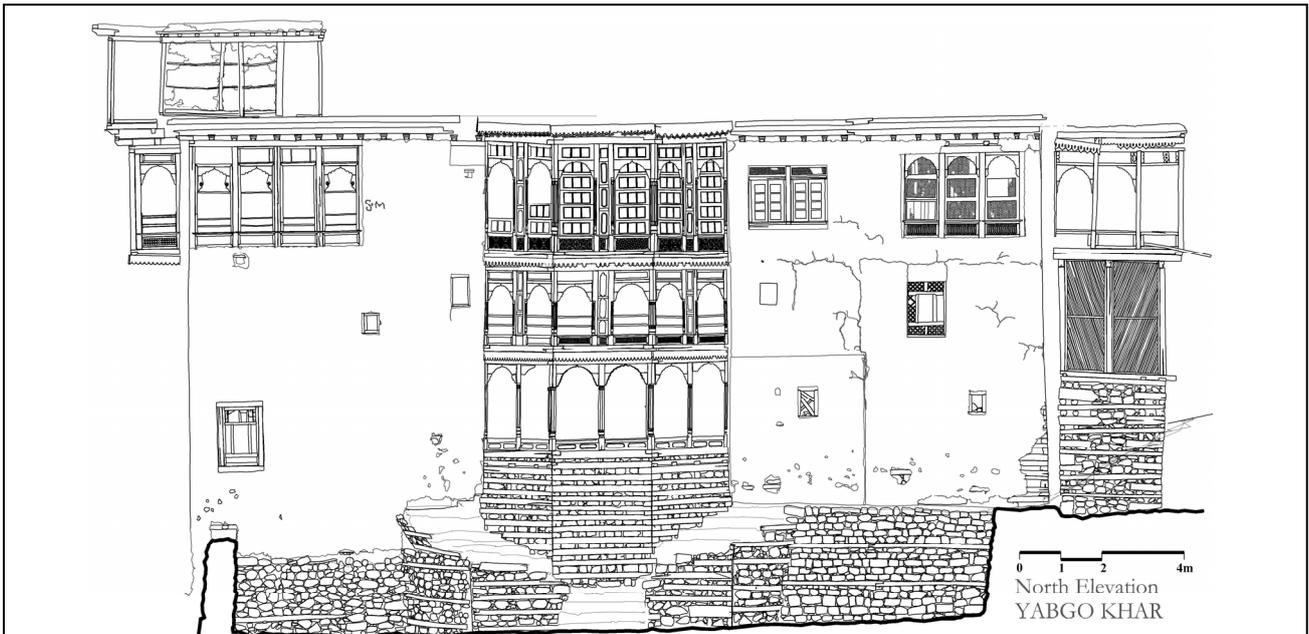


Fig. 16. North façade of *Khaplu* Palace. The wooden entrance loggia at the centre was the subject of major conservation activity in 2008. This restoration is very closely monitored with total station.

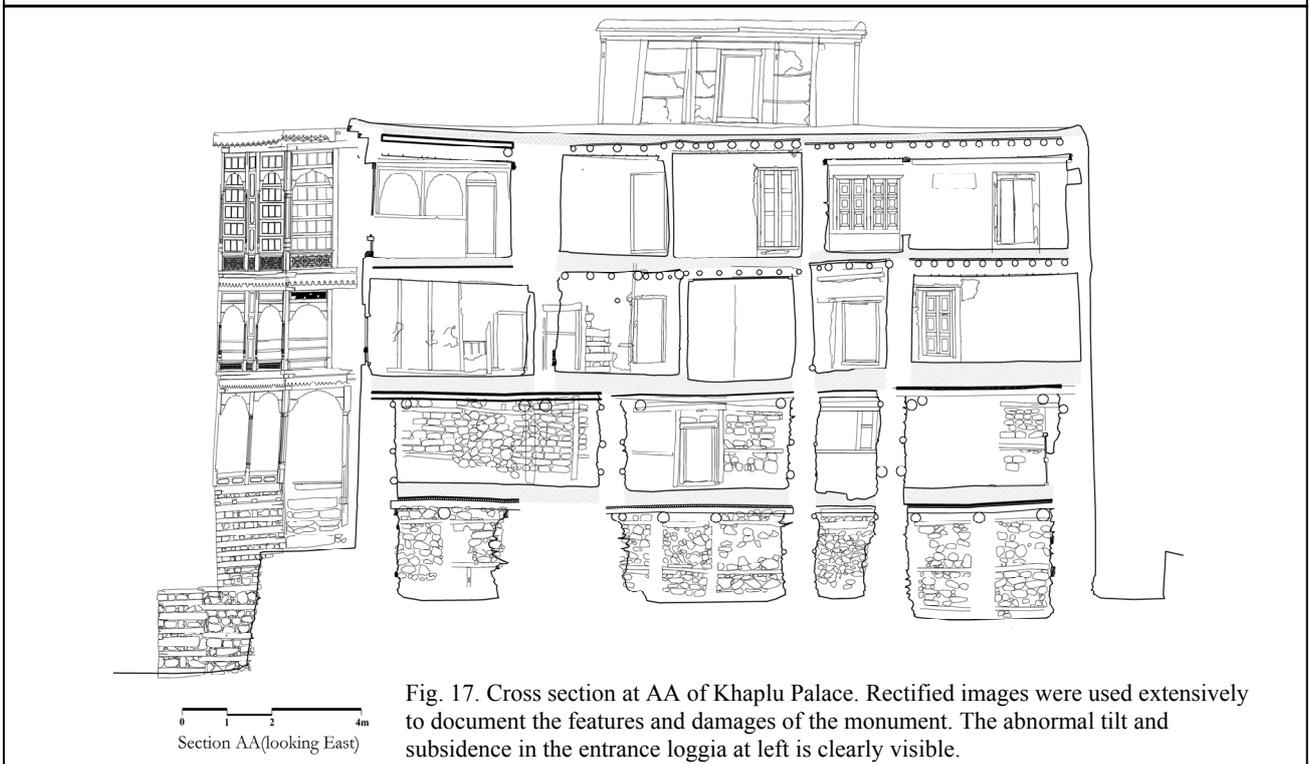


Fig. 17. Cross section at AA of *Khaplu* Palace. Rectified images were used extensively to document the features and damages of the monument. The abnormal tilt and subsidence in the entrance loggia at left is clearly visible.

## 6. REFERENCES

Almagro, A., 2007. Traditional drawings versus new representation techniques. In: *CIPA XX! International Symposium of Architectural Photogrammetry*. 01-06 October 2007, Athens, Greece.

Bianca, Stefano, 2005. *Karakoram: Hidden Treasures in the Northern Areas of Pakistan*. Umberto Allemandi & C. for The Aga Khan Trust for Culture, Torino.

Muhammad, Salman, 2006. Conservation and adaptive reuse of Khaplu Palace. Thesis Report, RLICC Katholike University, Leuven, Belgium.

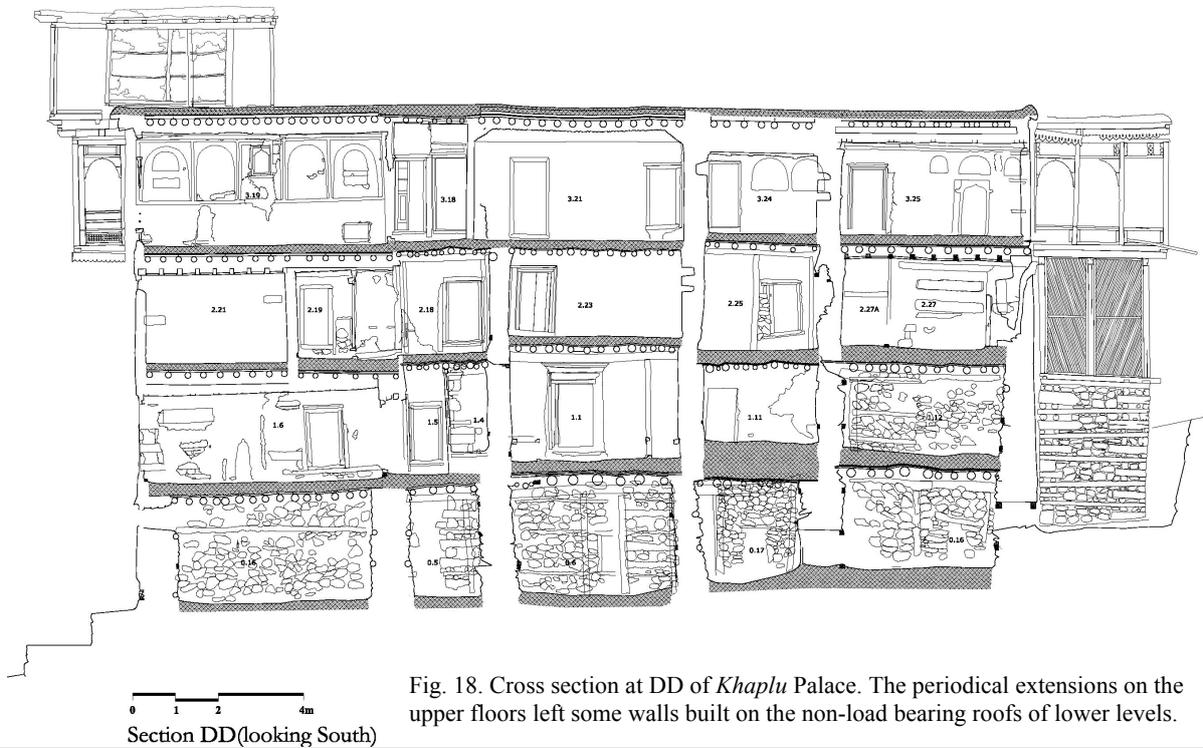


Fig. 18. Cross section at DD of *Khaplu* Palace. The periodical extensions on the upper floors left some walls built on the non-load bearing roofs of lower levels.

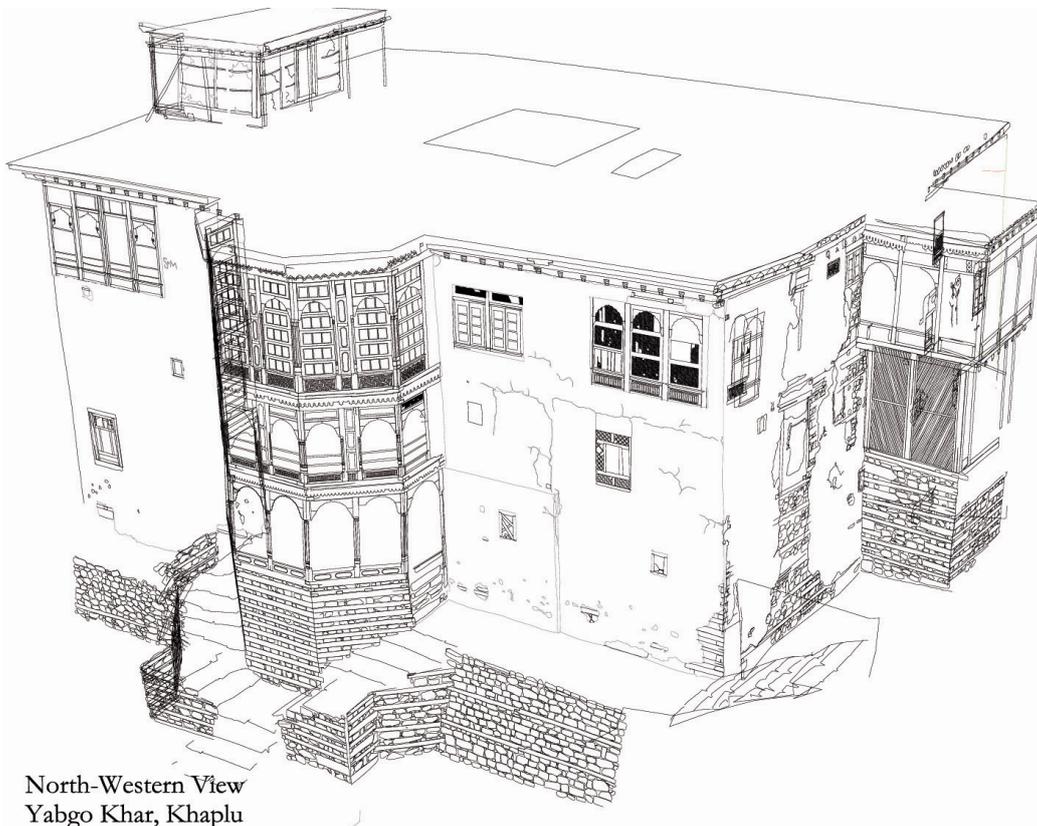


Fig. 19. A complete 3D wire-frame model of *Khaplu* Palace. North-western view of the Palace shows the swerve damages on western façade.