"Human" Technology in the Digital Era: Freehand Images and Analysis of Cultural Heritage – The Know-How and Its Applications

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Abstract. Rapidly developing advanced methods and techniques often displace the traditional ones. But might such "traditional" perception of the "old" as hopelessly outdated cause us to overlook its intrinsic qualities? Could a relevance for actual disadvantages be suggested, could a traditionally time-consuming technology be transformed into an effective one, with its original values preserved? This paper reconsiders the role of *freehand sketching* in modern conservation of cultural heritage by shifting the main focus from the **result** to the **process**. It presents a method, combined with the rapid learning methodology for achieving this traditional artistic ability, and examines its focused application to the visual analysis of cultural heritage by non-artist users. This paper demonstrates its wide accessibility to the general public and conservation experts, and examines its uses in modern multi-and interdisciplinary conservation of built heritage through recent results of the application of the method in national and international projects.

Keywords: Freehand sketching · Visual analysis · Conservation of cultural heritage (CCH) · Learning methodology · Documentation · Cultural heritage (CH)

1 Introduction: Structure of the Problem

Freehand images are traditionally associated with arts and art-related areas. Sometimes, historic images are used as an auxiliary source of information about historic monuments. However, active use of conservation-focused modern freehand image is not part of the methods presently applied to the contemporary conservation of cultural heritage. Exclusion of freehand images from this field might be understandable, due to several common assumptions:

(A) The use of freehand methods cannot produce precise and detailed results, compared to images produced by the use of high-technology techniques;
(B) Producing a freehand image is traditionally thought to be time consuming;
(C) Acquiring an acceptable skill in freehand sketching requires much time, effort and aptitude, which reduces its application to a very limited number of experts.

Are these A-B-C assumptions real? Can a proper solution be found to overcome the difficulties? Let us cast a fresh analyzing glance at the role of freehand sketching in the modern conservation of cultural heritage (CCH), and focus on the following questions which this paper addresses:

- *What* uses of freehand sketching and freehand images are relevant in the contemporary highly-technological field of conservation of CH;
- *How* can they be applied;
- *Who* can benefit from CCH sketches and sketching?

Actually, the above A-B-C assumptions focus on the outcome qualities, while they miss its *purposes*. In this paper, the sketch (image) is approached as part of the sketching process.

The paper presents the method of "Focusing the Eye" (FtE) on conservation-related data of each specific CH object. Combined with "Rapid Learning Methodology in Freehand Sketching" (RaLeMeFS), it can serve as a powerful tool for the analysis of CH objects for conservation purposes. The approach is based on methods initially developed, applied and introduced by the author in 2002, 2003, 2009 [1–3].

[FtE] + [RaLeMeFS] = [Visual Analysis Tool for CCH through Sketching]

The paper presents the results of recent development and application of the above methods in national and international projects. It demonstrates the easy applicability of the method, and exemplifies the results of its application by diverse types of users who had little or no experience in arts before the application period.

2   WHAT: Freehand Image as an Engine of Conservation Analysis

In the past, freehand sketching and drawing were an integral part of architectural education, and they were traditionally applied in conservation of built heritage [4, 5]. Architectural curricula produced the main heritage conservation expert force—conservation/ restoration architects, and included a significant number of courses in drawing, painting and sculpture, with many sources available [6–8]. Since the closing decades of the 20th century, the important development of advanced methods and techniques for collection, processing and production of visual and multi-dimensional data has led to a wide replacement of freehand techniques in both architectural and engineering education, and in the field of recording and survey of historic buildings. At the same time, the understanding of specific and unique values of freehand applications for architects, engineers and scientists is gaining more attention, and sometimes originates from the ICT community [9]. The role and uses of sketching as an instrument for creative synthesis in various areas of design have been profoundly studied over the decades [10–13]. Moreover, recent developments in sketch-based modeling are opening new opportunities of integration of freehand sketches as free input in computer-aided design [14–16]. However, the majority of architects and engineers seem to no longer possess the freehand drawing ability. Some developments, aimed at providing a short path to successful

drawing, are mostly addressed to general public [17], or non-conservation architects [18], but they don't have heritage conservation in mind.

In the context of CH conservation, the production and application of freehand images are commonly seen as fossils, with unchangeable properties. However, if we approach them as flexible and goal-adjustable, the spectrum of their uses may be extended significantly. This also allows reconsidering the A-B-C Assumptions.

With regards to *Assumption B: producing a freehand image is time consuming*; - indeed, it takes far more time to produce a free hand image than e.g. to take a photograph. But what are the aims of each action? Freehand drawing and precise imaging, produced with the aid of advanced technologies, differ by their driving forces. While advanced technologies provide a wide range of methods and equipment for data collection and multi-layer analysis, usually by means of pre-developed processes, a freehand image has a first-hand connection with the brain of its human producer. A freehand image is flexible and is produced through the immediate contact, reflection and reaction to the experience, perception, knowledge and understanding of its maker in real time (Fig. 1).
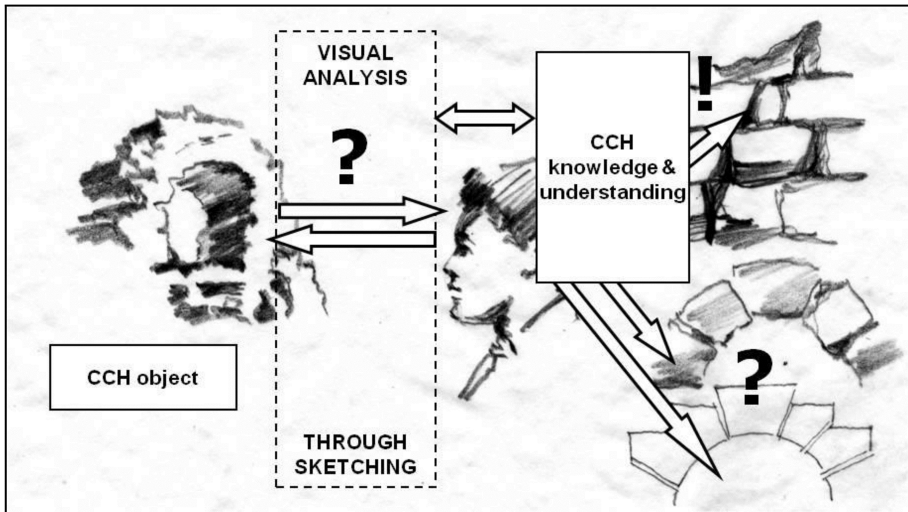

Fig. 1. CCH - targeted sketching process visual analysis © A. Lobovikov-Katz

In conservation of CH, a freehand image is more useful for analysis and decision making than for the accumulation of precise data. In many cases it is simply unnecessary to produce a detailed image which can be obtained by the use of advanced technologies. A sketch serves as a self-focusing instrument for its producer. Such a sketch should not be significantly time-consuming. In this context, the terms "image" and "produce" lose their original role, because the main focus here is shifted *from the result to the process of understanding and analyzing.* This is the major contribution of freehand sketching to CCH.

With regard to *Assumption A: the use of freehand methods cannot produce accurate and detailed results,* - accuracy can be achieved when a sufficient level of proficiency

in sketching is achieved through the learning process [19]. Now, let us focus on *Assumption C* which claims that acquiring an acceptable skill in freehand sketching requires much time, effort and aptitude, which reduces its application to a very limited number of experts. The major aim of "Rapid Learning Methodology in Freehand Sketching" is precisely to do this - to shorten the duration of the learning period needed to attain a sufficient level in freehand sketching. In this way, it allows practically everybody to quickly acquire a sketching ability, and open up sketch-powered visual analysis to wide range of users within and beyond the heritage conservation community.

Different types of conservation-focused sketchers might use freehand sketches in different ways. Conservation experts are capable of immediately understanding the conservation implications of their discoveries made through sketching, and the major outcome might be operational conclusions, rather than the sketch itself. However, sketchers who are not trained in conservation, but who produce a sketch with a specific focus on its contribution to CCH, cannot achieve full-scale conclusions resulting from their sketching process. In this case, the process of understanding which occurs during their sketching can help them produce the result - the sketch, - which should contain enough information to make it useful for its subsequent analysis by a conservation expert. In this case also, the sketch presents a visual result of a preliminary analysis purposefully focused on conservation by a sketcher who is not a conservation expert [20] (Fig. 2).
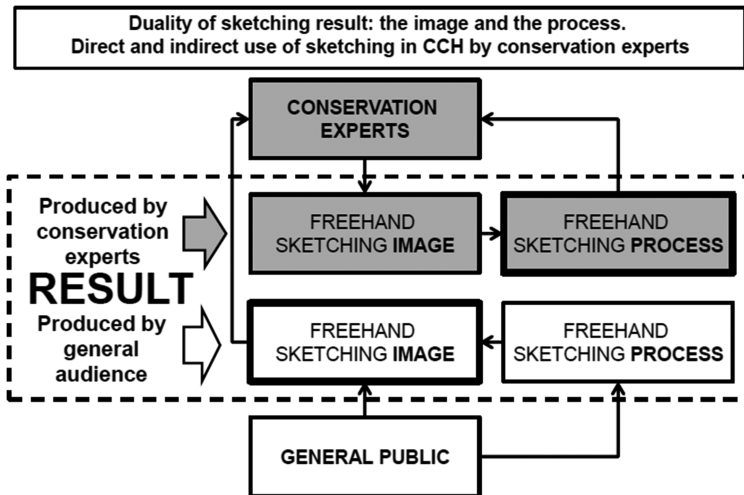

Fig. 2. Duality of sketching result: the image and the process. Direct and indirect use of sketching in CCH by conservation experts © A. Lobovikov-Katz

As demonstrated in the course of different educational heritage studying frameworks, sketching can be used to a varying extent and purpose at different levels of CH expertise, but they have a common basis - visual analysis, powered by the sketching process, activating deeper levels of understanding than by merely looking at a monument.

3 HOW: Focusing the Eye - CCH-Focused Visual Analysis in Sketching

Two skills are required from a sketcher for a successful representation for CCH:

- to perform an educated visual analysis of CCH objects:
- to produce an image of a CCH object.

This section focuses on the first skill as part of the sketching process - the ability to understand the visual data of a heritage object perceived by the sketcher. As shown in the European project ELAICH (Educational Linkage Approach In Cultural Heritage) that was carried out in the framework of the Euromed Heritage Programme 4 (2009–2012) - ELAICH ENPI-2008/150-583, it is possible to educate in a relatively short time an audience, non-trained in CCH, - to achieve a good level of understanding of CCH basic problems, by the use of "ELAICH Methodology" [21]. However, to enable a sketcher to produce a sketch of conservational analytical value, it is necessary to train his eye and mind to capture the multilayered data on site. To become effective for actual sketching, CCH focus should be formulated as simply as possible. At the same time, focus definition should not overlook the essence of CCH. This includes the efforts to understand and preserve a unique complex of values of each heritage object; the efforts on its recovering (to possible limits) from deterioration and preventing further decay, through respect to authenticity, taking into consideration methodologies, principles and the development of criteria. In this context, CCH is formulated as *reaching a balance between the values (positive) and the deterioration (negative) of CH objects* (Fig. 3). This simplified formula is the basis for focusing the Eye (FtE) of non-trained sketchers and it can be of use to both CCH experts and the general public in the real time of in-situ sketching.
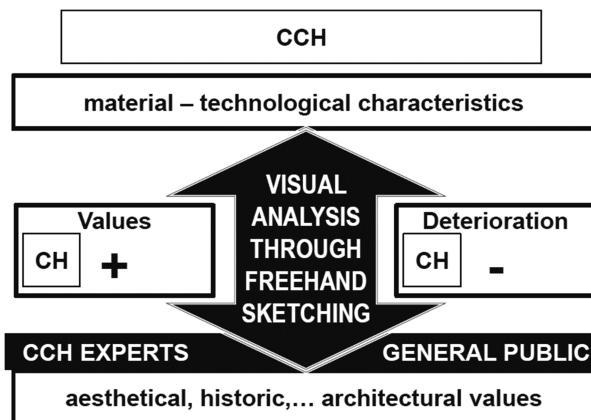

Fig. 3. Focusing the eye: capturing the characteristics of both the values and the deterioration of CH © A. Lobovikov-Katz

While conservation experts are highly knowledgeable in their CCH area, they still need to sharpen their skills in the unfamiliar area of CCH sketching. It is not easy for an untrained-in-the-art sketcher to capture and transmit to/by sketch many of the visual characteristics of a sketched object. This might be caused not merely by the complexity of the sketching process, but also in the difficulty to combine analytical thinking with creative processes. Furthermore, experts from many areas of science and technology are involved in the contemporary conservation of cultural heritage, and some of them do not deal with the analysis of historic buildings or sites on a daily basis, e.g. experts in analytical chemistry need to develop different skills for sketching than those required in their laboratory.

For the general public, who are not conservation experts, such guidance is indispensable. For them, it is necessary to go further, and get more into details, such as learning to perceive an entire edifice as an entity combined of its integral parts: geometry (shape, space) and materials [22]. Both geometry and materials play an active role in solving contradictions frequently encountered on historic monuments, such as between the urge to preserve an architectural value of a building or a detail, versus its poor physical state. The difficulty of conservation decisions and interventions may be rooted in the fine geometry of an authentic detail and the inability to preserve it due to lost geometry of its present state, while geometry is lost through the loss of material, and possibly - the loss of structural stability. Developing awareness and understanding of such problems sharpens and educates the visual focus of general public sketchers. Their efforts in actual sketching are based on this solid intellectual basis - not just looking at a building but to know where to look and what to look for.

In Fig. 4, macro geometry relates to a large-scale built heritage object, - the entire architectural ensemble, structure, building or its large parts. Micro geometry relates to elementary single units, e.g. a single stone, column capital, etc., with attention to both
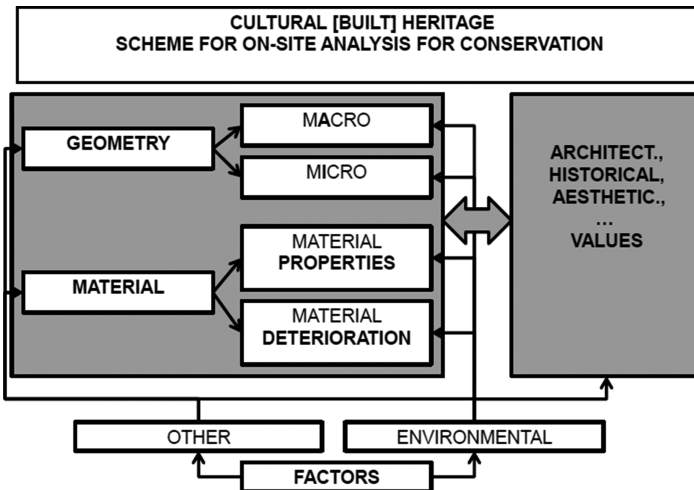

Fig. 4. Focusing the eye: capturing the characteristics of both the values and the deterioration of CH - between geometry, material and environment © A. Lobovikov-Katz

material properties and material deterioration. This simple scheme demonstrates the interconnection between environment, geometry and material, with regard to both the values and the deterioration, e.g. the original architectural choice of building material depends on its availability, and at the same time its original material properties predetermine its durability under specific environmental conditions.

"Focusing the eyes" of CCH sketchers should be undertaken before the start of their actual on-site sketching of historic buildings. This should be combined with introducing the actual methodology for freehand sketching based on the author's Rapid Learning Methodology in Freehand Sketching.

4 WHO: Accessibility of the Method, Its Uses and Application Examples

In order to sketch, a basic proficiency in freehand sketching is needed. The method is accessible to practically everybody, through the Rapid Learning Methodology in Freehand Sketching. This section of the paper presents several examples of its application combined with FtE - "focusing the eye" on CCH. Different types of participants, from high school students to conservation experts took part in the sessions given by author, in the framework of several projects. The majority of all participants had no experience in freehand sketching before the sessions. Duration of learning-sketching sessions was different for each group, as was the relative duration of introducing the sketching methodology (RaLeMeFS) and the "focusing the eye" on CCH.

4.1 Case Study 1: The Use of CCH Freehand Sketching by CCH Experts

This example demonstrates the use of CCH freehand sketching in the course of a pilot learning experience undertaken in sessions on "Understanding cultural heritage through sketching – rapid learning methodology" as part of the Training School, organized by COST i2MHB and the Fundación Santa María la Real del Patrimonio Histórico on its premises in Aguilar de Campoo in Spain, January 27–29, 2016.

As part of the Training School, sketching sessions (2 h lecture and demonstration; home work; 2.5 h practical application on a historic site; 1 h conclusion and analysis of results) were given by the author to a group of experts, MSc and PhD students from the following areas of CH conservation: history, archaeology, architecture, art history, sociology, cultural heritage, conservation of cultural heritage, civil eng., building pathology, chemistry, electrical eng., economics, management. Some participants came from a combined educational background in several areas, i.e. BSc., MSc., and PhD in different fields. Only a small number of participants were architects.

At the conclusion of the sessions, participants filled in questionnaires. Of 22 participants, 8 had no experience in freehand drawing, sketching or painting before the sessions, 2 had "almost none" or "very little" experience (45 % altogether), while 12 participants had experience in this area.

There was very little difference between the two types of participants with regard to the main difficulties during the sessions. As reported by the participants, many

difficulties were related to capturing "perspective" and "proportions". 50 % of the participants with no or very little experience in sketching wrote that "everybody can learn to draw", as an answer to their summing up of the session.

72 % of all participants answered that sketching is useful for every expert in this field. Majority of participants were interested in further learning of sketching. 86 % of all participants were planning to use sketching in their main field of work. According to participants' answers, a wide range of possible general uses of sketching in conservation of cultural heritage could be possible. The participants provided interesting and often unusual answers. One answer expresses the essence and relevance of sketching for understanding and preserving of cultural heritage. This was provided as an answer to the question: Q: "What can be the use of sketching in conservation of cultural heritage in general (if any?)". A: "To sketch what you do not see". This quotation puts in a nutshell the great value of sketching as a tool for deepening the understanding and discovering the data which is often "invisible" to a non-sketching observer.
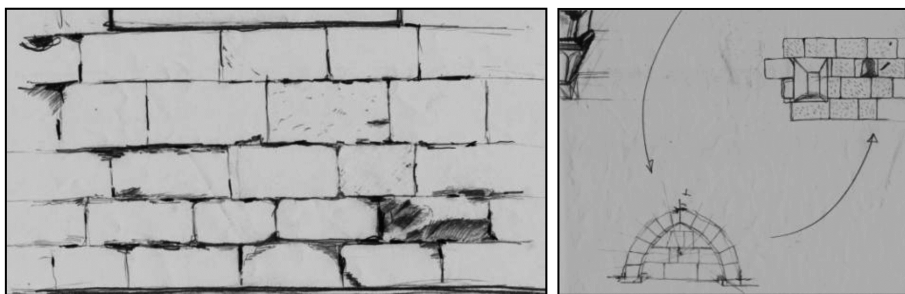

Fig. 5. Sketches, produced by two conservation experts - participants of practical session on "Understanding cultural heritage through sketching", as part of the COST i2MHB Training School, Fundación Santa María la Real del Patrimonio Histórico, Spain, 2016: FtE and RaLeMeFS were applied. Both participants (D.Sc., construction economist (left) and MSc, building engineer; restorer (right)) had no previous experience in sketching, painting or freehand drawing before the session. Nevertheless, the sketches demonstrate accurate graphic analysis of geometry and material, including visible diverse degrees of deterioration.

After the lecture and demonstration, during the practical part of the session at the historic site, the participants were asked to pick a detail or a small portion of a wall or structure on which to focus their sketching. In spite of the short duration of the practical session, some participants without previous experience in sketching showed very good results. Some sketches of "newcomers to the art" demonstrated attentive visual analysis of conservation problems of a historic monument. At first, many participants experienced difficulty with proportions and perspective. However, many quickly grasped the rules and discarded their mistakes already by the end of the 2-hour sketching session. At the same time, they apparently enjoyed "understanding heritage through sketching", which possibly helped them to persist until completing their task in the severe winter cold of Northern Spain. To conclude this specific experience, the main value of CCH sketching by conservation experts is "fueling" the process of their analytical understanding rather than the production of a detailed sketch. At the same time, FtE-aided

sketcher-sketch analytical dialogue should be based on an acceptable level of sketching which can be achieved by RaLeMeFS (Fig. 5).

4.2   Case Study 2: The Use of CCH Freehand Sketching by General Public - The Case of High School Students

This example presents a very short session given by author to a group of some 25 students of the Ben Zvi high school at Kiriat Ono, with the support of and at the premises of the Society for Preservation of Israel Heritage Sites (SPIHS) at the Mikveh Israel School Visitor Centre in Tel Aviv, Israel, in May 2016.

The students had several introductory meetings to the conservation of cultural heritage provided by the SPIHS experts before this session. They had no previous experience in sketching. The session duration was about 1.5 h. It included the "Focusing the Eye" part and a short review of different types or projections; a very brief explanation and demonstration on sketching methodology (RaLeMeFS); and about 20 min of practical sketching of historic buildings or their elements. Introduction to and practicing RaLeMeFS were too short (about 40 min altogether) to prevent mistakes in proportions and perspective, which affected negatively the reliability of many sketches.

However, students' choice of their sketching subjects demonstrated their ease and success with using FtE. Right from the start of the practical part of the session, as they stepped from the classroom into the historic compound, they "focused their eyes" on conservation problems and values, e.g.: artistic values and material deterioration of specific architectural elements, material deterioration problems of plaster; cracks in buildings and supporting walls; etc (Fig. 6).
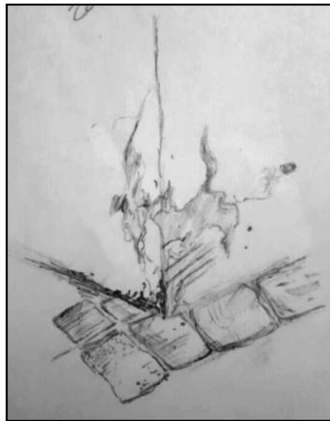

Fig. 6. Fast on-site sketch by a high-school student at a practical part of a lesson on understanding historic sites through sketching: material deterioration of a ground storey corner of a historic building, and pavement.

4.3 Case Study 3: The Use of CCH Freehand Sketching by Non-conservation Architecture Students

These architecture students had no previous course in conservation. Some of them took a course in architectural drawing assisted by RaLeMeFS. Freehand sketch demonstrated here was produced in the framework of the course in documentation and survey of historic buildings and sites. The course was given by the author at the Faculty of Architecture and Town Planning, Technion – Israel Institute of Technology in Haifa. It consisted of lessons in a university classroom, exercise in Haifa, and three to four days of precise measurements on a World Heritage site in Acre (Akko) with the help of simple equipment supplied by the Transportation and Geo-Information Engineering section of the Faculty of Civil Engineering. This course had a strictly precise orientation. At the end of the course, students had to produce several layers of mapping according to guidelines. Freehand sketching was not required. Furthermore, CAD disciplines dominate the faculty curriculum, with a very limited number of freehand-related, not obligatory courses. Nevertheless, the few participants who succeeded to acquire basic sketching skills before this course used sketching to the benefit of their documentation teams. Furthermore, the sketch of a heavily deteriorated column capital, presented here, helped
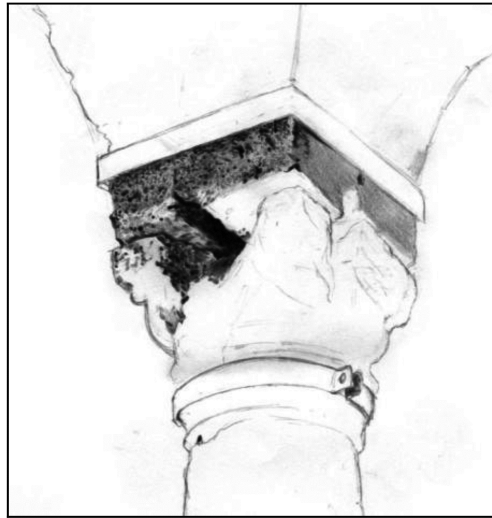

Fig. 7. Sketch from a field book, part of the teamwork in students' documentation and mapping project, in the course "Documentation of historic building and sites" Faculty of Architecture and Town Planning, Technion, (supervised by the author) 2011. Sketch by Ori Roll. This freehand sketch focuses on severe deterioration of the column's capital. It also points out the initial visible stage of detachment of a stabilizing metal brace beneath it; and hints at material deterioration of an arch above the capital, on the left. Basing his opinion on this sketch, a conservation expert might recommend urgent engineering investigation of such details of the courtyard in order to examine their material deterioration and structural stability altogether. In the specific context of this students' project, the sketch helped them to discover and analyze the main natural deterioration cause on this part of the monument.

them to formulate the right questions and reach correct conclusions about the main deterioration causes, their geometrical distribution on the monument, and relative dating of the capitals of the courtyard (Fig. 7).

As demonstrated by these examples, on-site sketching brings the sketching person to deeper levels of understanding than by merely looking at the monument. This is true for both high school students and conservation experts, though their use of sketching differs.

5   Conclusions

Human visual system is able to process complex data, including information on both geometry and materials of complex objects. Combining this natural ability with a focus on conservation data and problems of an observed cultural heritage object with the help of FtE (Focusing the Eye), and at the same time activating the process of visual analysis through sketching, can be an invaluable aid to the conservation of cultural heritage. FtE, supported by RaLeMeFS, allows for the inclusion of traditional freehand sketching into modern interdisciplinary and multidisciplinary conservation research and practice. Due to its simplicity, the method can be used by the general public and therefore enable large numbers of historic monuments to be studied and monitored regularly on a basic level. The results of such wide active visual observation can be used by conservation experts. Furthermore, conservation experts can use this method directly, to effectively enhance their process of visual analysis of historic buildings and sites under study or conservation. This method can be also applied by other heritage-related communities, who have become more involved in conservation in recent decades, e.g. archaeologists.

Activating visual analysis by FtE and RaLeMeSF, successful results of involving e-learning in the education of the general public for CCH [23–25], and the rise of interest and achievements of the digital community in the development of sketch-based modeling in the recent decade [26] add new dimensions to an old traditional, two-dimensional technique of freehand sketching.

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