The Perception of Small Scale Damage and Repairs of Natural Stone

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ABSTRACT

By means of a questionnaire a study was carried out to investigate the perception of small scale damage and repairs of natural stone used in buildings. Participants were asked to evaluate damage to natural stone shown on pictures. They were also asked to give their opinion on interventions needed to preserve or restore the material. Significant differences can be found between specialists and non-specialists in conservation.

Respondents consider some cases as “damage” situations, even though no intervention is deemed as necessary, as if damage was a sort of natural weathering, thus to be expected and accepted. In other cases, also defined as “damage” situations, interventions are considered necessary. This seems to imply the use of a different criterion to define “damage”, maybe including the expected risks related to its development. This study contributes to the definition of damage, and to a better understanding of the criteria used by different people to decide on the need of interventions.

KEYWORDS

Perception, Conservation, Damage, Natural Stone, Intervention.

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1 INTRODUCTION

Decisions about the conservation of monuments often depend on different technical considerations, such as the acute need of preservation, material properties or arguments regarding the artistic value of the object. It includes sometimes a reconstruction, and in practice, non-technical arguments relating to public appreciation, tourist concerns, or even political purposes [e.g., Von der Dunk 2006]. Assuming that these considerations are often made by persons with different interpretative frameworks, depending on their education and professional experience, a clear definition of damage is absolutely necessary as a starting point for any decision on interventions. The definition of damage should be objective and commonly accepted. Several glossaries combined with damage atlases have been developed over the years, involving a wide range of specialists in conservation [e.g., Van Hees & Naldini 1995, Franke et al. 1998, Van Balen et al. 1999, Fitzner & Heinrichs 2002, Naldini et al. 2006; see also the ICOMOS International Scientific Committee for Stone, http://www.lrmh.culture.fr/-icomos/icomos/consult/index.htm]. Still the definition of damage is not unambiguous, but rather subjective, which partly explains the different approaches shown in monument conservation.

Situations (i.e., damaged buildings) that are technically identical are often handled in different ways, depending on the building concerned and the people involved in the conservation process. Apparently, the technical arguments are not decisive. Probably, decisions are also based on non-technical arguments like intuition, aesthetics and perception. Further, it is not clear whether, from the same perspective of intuition, aesthetics and perception, the results of the intervention (repairs, cleaning) are considered to be an improvement, especially by non-specialists. Though they play a major role in everyday decision making on conservation, non-technical arguments such as perception in relation to replacement or preservation have not been widely researched. This study is aimed at assessing which factors are involved in deciding whether deteriorated building parts should be preserved, restored, reconstructed or replaced.

In this study, pictures of small scale damage (i.e., damage to individual stones or small sections of a wall) have been submitted to the participants for evaluation, because it is expected that in these cases non-technical arguments would determine their decisions far more than in the case of large scale damage (i.e., entire façades). When facing large scale damage, technical surveys are commonly carried out and decisions based on perception are supposedly minimized.

2 METHODOLOGY

2.1 Questionnaire

The methodology of this study was inspired by research of Andrew [2002] on the perception of weathered stone façades, and earlier studies on perception by Van Wegen [1970] De Jonge [1971] and Steffen [1983].

A questionnaire was composed of 20 images of natural stone; both weathered/damaged and repaired (Fig. 1). Each of the images was accompanied with 11 statements to be answered on a 7-point scale ranging from “totally agree” to “totally disagree”. The research was related to the Dutch conservation world, therefore, the questionnaire was in Dutch. The questionnaires were sent to people known to be interested in and/or working in the field of conservation of natural stone, architects, geologists and students attending courses on building conservation. To have the layman’s opinion, the questionnaire was also sent to family and friends who do not have a professional relation to conservation of natural stone. The questionnaires were distributed in colour-printed form. All the images had a printed size of 80 mm height. The returned questionnaires have been processed using standard spreadsheet software, where the 7-point scale is entered as 1-2-3-4-5-6-7 (1 being totally agree and 7 being totally disagree).
Figure 1. A-T. The twenty images that have been used in the questionnaire.
2.2 Statements

Several historic examples show the diversity of arguments used to underline a conservation approach [e.g., Quist & Van Hees 2006]. Based on an overview of the most recurrent arguments, 11 statements have been used to capture the perception of small scale damage and repair of natural stone:

1. The stone shows damage.
2. The stone is attractive.
3. The stone needs maintenance.
4. The stone shows natural weathering.
5. The stone is well looked after.
6. The stone needs to be repaired.
7. The stone is in good condition.
8. The stone is ugly.
9. The stone needs to be cleaned.
10. The stone looks neglected.
11. The stone needs to be replaced.

2.3 Response

Out of 230 questionnaires, 102 usable questionnaires have been returned, a response of 44%. Respondents had to choose a profession out of a list; it was allowed to choose more than one profession. It is remarkable that almost all architects working in the field of conservation chose both the profession of “specialist” and “architect”. The distribution is as follows: Student: 12 (10%); Specialist in the field of conservation: 49 (39%); Architect: 26 (21%); Geologist: 13 (10%); Other: 25 (20%). Due to a low response in most of the predefined populations, only the “specialists” and “the others, not being specialist” can be used as a different population within the analyses. The architects-population seems usable, but 17 out of 26 respondents are also part of the specialists-population. The remaining 9 respondents can not be used as a separate population.

3. INTERPRETATION

3.1 Mean Average and Standard Deviation

For every question on the questionnaire, the mean average (\(\bar{x}\)) and the standard deviation (\(\sigma\)) were calculated. Figure 2 shows a graphical representation of \(\bar{x}\) and \(\sigma\) of all statements regarding the ninth image. Figure 3 shows a graphical representation of \(\bar{x}\) and \(\sigma\) of the first statement (damage) regarding all images (see Fig. 1 A-T). In both cases all the respondents were taken into account. Figure

\[\text{Figure 2. } \bar{x} \text{ and } \sigma \text{ of all the statements regarding image 9 (Fig. 1-I).}\]

\[\text{Figure 3. } \bar{x} \text{ and } \sigma \text{ of all the first statements (damage) regarding all images (Fig. 1 A-T).}\]
2 and 3 serve as an example to illustrate the high statistical dispersion. All the other $\bar{x}$ and $\sigma$ show the same tendency. In general, the dispersion is lowest for image 18, and highest for image 5; images 2, 7, 8, 16 and 20 also show a very high statistical dispersion.

There are 2 possible explanations for this high statistical dispersion:  
1. The total population is not homogeneous. The perception of the specialist population significantly differs from the non-specialist population.  
2. The statements used in the questionnaire do not distinguish enough.

### 3.1.1 The Total Population Is Not Homogenous

To check whether there is a significant difference in perception for the specialist-population and the non-specialist-population, the student’s homoscedastic t-test, with a two tailed distribution was carried out. With this test, 220 data ranges (20 images with 11 statements each) were processed (see table 1). For 85 out of the 220 data ranges can be concluded that $\bar{x}$ differs significantly ($p=5\%$). This proves that, in relation to a lot of statements and images, there is a different perception of small scale damage and repair of natural stone for both populations.

Six out of twenty images show significantly different mean averages for both populations. These images are 3, 5, 11, 12, 16 and 20, of which four images concern repaired natural stone. Looking at the statements, four (statement 2, 8, 9 and 10) appear to differ significantly for over 10 images. The specialists tend to judge the images more positively in relation to the statements “attractive”, “ugly” and “neglected”. The opinion of the specialists in relation to “cleaning” differs for 18 out of 20 images significantly.

#### Table 1. p-values to check whether $\bar{x}$ differs significantly for both populations.

<table>
<thead>
<tr>
<th>Question</th>
<th>Image 1 (%)</th>
<th>Image 2 (%)</th>
<th>Image 3 (%)</th>
<th>Image 4 (%)</th>
<th>Image 5 (%)</th>
<th>Image 6 (%)</th>
<th>Image 7 (%)</th>
<th>Image 8 (%)</th>
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#### 3.1.2 Explaining High Standard Deviations

Further analyses of the frequency distributions of scores on statements with high standard deviations show that there are two types leading to the same high $\sigma$, namely:  
1. The scores are almost evenly distributed to all seven items on the 7-point scale. The histogram shows an almost horizontal linear trend. This concerns statements 2, 5, 7, 8 and 10.  
2. There is a high concentration of scores on either the “agree-side” and the “disagree-side”. The histogram shows a parabolic trend. This concerns statements 1, 3, 6, 9 and 11.

T 15, The Perception of Small Scale Damage and Repairs of Natural Stone, Wido Quist et. al.
This division can be assigned to types of statements. The evenly distributed scores all concern the more “soft”, personal statements and the polarized scores all concern the more “expert, technical, objective” statements. These phenomena can be found in all three populations (total, specialists, and non-specialists). Two opposite opinions exist with regard to damage, maintenance, repair, cleaning and replacement.

3.2 Correlation

Both the specialist-population and the non-specialist-population show four pairs of statements indicating linear regression: -0.6 < r (PMCC) > 0.6, see table 2. In addition, two more correlations can be found in the non-specialist-population.

Table 2. Statements that show linear regression.

<table>
<thead>
<tr>
<th>Population specialists</th>
<th>Population non-specialists</th>
</tr>
</thead>
<tbody>
<tr>
<td>The stone is attractive and the stone is ugly (r = -0.82)</td>
<td>The stone is attractive and the stone is ugly (r = -0.77)</td>
</tr>
<tr>
<td>The stone needs maintenance and the stone needs to be</td>
<td>The stone needs maintenance and the stone needs to be</td>
</tr>
<tr>
<td>repaired (r = 0.68)</td>
<td>repaired (r = 0.72)</td>
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<tr>
<td>The stone is well looked after and the stone is in good</td>
<td>The stone is well looked after and the stone is in good</td>
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<tr>
<td>condition (r = 0.64)</td>
<td>condition (r = 0.67)</td>
</tr>
<tr>
<td>The stone is well looked after and the stone looks neglected (r = -0.65)</td>
<td>The stone is well looked after and the stone looks neglected (r = -0.67)</td>
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</table>

The strong negative regression between “attractive” and “ugly” indicate that these statements are considered to mean the opposite. The same counts for “well looked after” and “neglected”. The linear regression between “maintenance needed” and “to be repaired” shows that in most of the cases when talking about maintenance, people want to intervene by repairing the natural stone.

After a first analysis of the results, some images have been grouped to investigate whether linear regressing according to comparable cases of damage can be demonstrated:
1. Sandy limestone on several scales (images 1, 9 & 13)
2. Repair (images 5, 7, 8, 11 & 20)
3. Larger scale, “wide-angle” (images 1, 10, 13 & 17)
4. Obvious loss of material (images 2, 3, 15 & 19)
5. Scaling (images 3, 9, 16, 18)
6. Sandstone degradation (images 2, 16)

Despite the assumed similarity between these groups of images, no correlation can be found.

4 DISCUSSION AND CONCLUSIONS

If all respondents are evaluated as one group, some interesting observations can be made on a number of situations regarding the question whether a situation is considered to be damage (statement 1) and if so, whether or not intervention (statements 6, 9 and 11) is necessary (Fig. 4). In some cases, the situation shown by the images is considered as damage, but accepted, without any intervention deemed to be necessary. This holds for images 6 (pronounced layering due to weathering), 9 (exfoliation), 13 (wide angle view of blocks with exfoliation) and 19 (spalling). Perhaps, these cases are considered as a kind of natural weathering. In contrast, regarding images 2 (sanding), 14 (joint), 15 (strong exfoliation) and 18 (strong powdery and exfoliation), the situation is also associated with

T 15, The Perception of Small Scale Damage and Repairs of Natural Stone, Wido Quist et. al.
“damage” (statement 1), but most respondents consider intervention to be necessary. An explanation for the different inclination (whether to intervene or not) between both series of images may be the observed impact or expected future development of the damage. Another interesting situation is provided by image 10, an example of biological growth on tuff stone masonry. About 50% of the respondents consider this situation as damage. Also, about 60% states that an intervention is necessary. Obviously, those who consider biological growth to be damage, always deem that repair is necessary.

![Figure 4. Comparison of the response on the issues of damage (statement 1), maintenance (statement 3) and intervention (statements 6, 9 and 11) of all respondents together.](image)

It is impossible to point out the exact differences between predefined groups of people due to a low response within most of the groups and the high $\sigma$. Despite this, it is possible to observe some tendencies, especially in relation to statement 1 (damage). In general (Fig. 5): Students tend to give low scores (i.e., tend to agree); Geologists tend to give high scores (i.e., tend to disagree) especially image 6, 8 and 10; Response of the conservation specialists and architects on the images 5, 12 and 20 tend to diverge from the others.

The response by the students may possibly be explained by a lack of knowledge and experience, which makes them consider all kinds of degradation as “damage”. The response from geologists clearly shows that (small scale) damage to natural stone is not an objective term. It is defined depending on the background and interpretative framework of different specialists. This is illustrated by the fact that geologists do not consider material degradation due to natural processes (i.e., weathering) as damage, and, consequently as reason for intervention. Apparently, the fact that internal characteristics of the stone, such as layering or presence of fossils, become more pronounced and better visible due to weathering processes (as in image 3), may even be appreciated. The stone is considered to express itself to a larger extent, and to gain charm by ageing. To some extent, this concept is comparable with the noble patina of age and (referring to paintings) *time as a painter* [Gombrich, 1988] sometimes invoked in art theory. On the contrary, conservation specialists and architects tend to associate the same result with damage, probably because it changes the original conception of a façade, and tends to erase the working of the stone by stone masons and artists. The definition of damage depends on the education and professional experience of the person involved, rather than on objective criteria, which influences how decisions about intervention are made.
Decisions about interventions are not only based on the direct need of conservation in order to preserve material and building, but are also made to enhance a building, street or neighbourhood in a way ‘the general public’, ‘visitors’ or ‘tourists’, supposedly appreciate. A clean façade or neat blocks of stone are often regarded as ways to get this appreciation. The results allow some interesting reflections on this point.

Images 11 and 20 show situations in which a repair is visible. However, if all respondents are grouped together (Fig. 5), most of them (c. 85 %) consider the repair shown in image 11 to be damage. Many of those 85 % even consider intervention to be necessary. The situation shown in image 20 - a close-up of a recently executed sandstone repair - is clearly seen as the more successful one (Fig. 4). However, conservation specialists and architects apparently feel different about what is a successful repair from the general public. Architects and monument specialists highly appreciate the repair, in contrast with the other respondents (Fig. 6).

In general, conservation specialists and architects seem to have a greater appreciation of repairs than the general public. The latter still tend to consider a repaired stone “damaged”. The specialists recognize the situation from their professional experience, and assume that this was the only option to
preserve the block of stone. Contrary, the non-specialists do not judge the actual repair, but “the disturbed, not naturally looking, not original situation”. Opinions of “creators”, judging the repairs positively, and “observers”, judging the repairs negatively, consequently diverge. This implies that, when appreciation by the general public is one of the motives for intervention, initiators of this intervention (such as owners of a building, authorities, etc) may not obtain the desired result.

With regard to cleaning, the situation is the opposite. Whereas non-specialist in general do not appreciate the repairs, they tend to opt for cleaning as an intervention. In contrast, specialists are (very) negative to cleaning, whilst they appreciate the repairs. Specialists are probably aware of the technical implications of cleaning, and the damage that may result from it. In this case, new methods enabling damage-free cleaning might combine public appreciation with professional care.

REFERENCES


