# 4.9. HEALTH AND SAFETY AT THE RESTORATION WORKS OF THE ACROPOLIS MONUMENTS (GREECE)

**Key points**

- Restoration works have significant health and safety risks for a number of workers involved, from workers in the scaffolds to marble artisans.
- A holistic risk assessment highlighted the importance of taking into account health and safety risks when designing and executing the work.

## Introduction

The Hellenic Institute for Occupational Health and Safety, in collaboration with the service for the restoration of the Acropolis monuments (YSMA, Greek Ministry of Culture), carried out in 2002 a study to assess the risk factors and their consequences on the health and safety of workers at the restoration works of the Acropolis monuments.

The Hellenic Institute for Health and Safety (Elinyae) is a bipartite, non-profit organisation established in 1992. Its purpose is to provide scientific and technical support to all those involved in occupational health and safety, as well as to contribute to the improvement of occupational health and safety by advising the policy-makers and legislators in Greece. Apart from the central Athens branch, at the moment there are three regional branches in operation: one in Thessaloniki, one in Tripoli and one in Ioannina.

The service for the restoration of the Acropolis monuments (YSMA) manages all restoration works on the Acropolis and falls within the jurisdiction of the Greek Ministry of Culture. A total of 233 people are employed at YSMA and comprise engineers, archaeologists, conservers and technicians.

This project was initiated after YSMA requested Elinyae to contribute to the risk assessment.

## Background of the action

The restoration works began in 1975. For the restoration of the Acropolis monuments five worksites have been set up: one at the Parthenon, one at the Propylaia, one at the Temple of Athina Niki, and a conservation site and a site for the marble parts. The restoration works include dismounting parts of the monuments and transferring them to conservation laboratories where new parts are constructed. These restored parts are then replaced on the monuments where finishing touches are made, *in situ*.

The restoration works of the Acropolis monuments often present many complexities and particularities. In particular, the worksites are operating concurrently in an area of the archaeological site that is visited by thousands of tourists. In addition, the total work area is limited in space given the fact that it is on the rock of the Acropolis. Also, due to the fast corrosion of the monuments, it is necessary to set up a worksite in a hasty manner, which may result in safety measures not being taken. Because it is prohibited to intervene on the monuments, it becomes difficult to improve safety measures at scaffolds as is commonly done on conventional construction projects.

| | Number of accidents | Working population | Incidence rate |
|---|---|---|---|
| Construction | 4 266 | 208 029 | 20.51 |
| Total (all sectors) | 16 822 | 1 553 647 | 10.83 |

*Comparison of accident statistics in the construction sector and all sectors for the year 2000 in Greece*

No accident was reported during the restoration works of the Acropolis monuments. A major factor for this was the skills and experience of the workers employed on this project. The workers' main concern was the marbles themselves. As extremely valuable archaeological artefacts a great deal of importance was attached to preventing any damage being caused. This had consequences on safety and health in that many modern preventive measures could not be used.

## Ambitions of the action

The study was initiated following an enquiry from YSMA addressed to Elinyae on how to apply health and safety legislation at the Acropolis monuments given their particularities. Elinyae suggested a comprehensive OSH study should be implemented. The objectives of the study were the recording and assessment of OSH risks at restoration works with hygiene monitoring and safety audits as well as medical examinations.

Initially the main aim of YSMA was to prevent serious accidents, especially falls from scaffolds. Following this it was conceded to broaden the study to encompass more aspects of health and safety. YSMA's interest in this collaborative effort was that at the end of the day they would acquire a 'custom-made' 'OSH plan and file' and risk assessment data.

## Scope of the action

The study was conducted in 2002 and lasted for the entire year. There was no financial obligation on YSMA for the study since Elinyae provides its services free of charge. The procedure followed was conducted in three phases.

First, questionnaires were distributed to all workers that addressed risks for safety, health and ergonomic risks as well as symptoms. This not only involved the participation of the workers but also provided a first overview of the hazards. The results of the questionnaires revealed that the basic risk factors were slippery floors, work at great heights, handling of hazardous equipment, dust, noise, manual handling and bad postures, and high temperatures especially during the summer period. Musculoskeletal disorders and stress were the most prevalent symptoms. The complete lack of training in health and safety matters became obvious.

The second phase included documentation of risks. Measurements were carried out for noise, dust, the presence of BTEX compounds (benzene, toluene, ethyl-benzene, xylenes), lighting, microclimate and static friction. Also safety audits were made at all workplaces. These findings confirmed the existence of risks.

Finally, medical examinations (audiometry and spirometry) were conducted on a sample of workers exposed to noise and dust (108 workers with an average of 10 working years).

For the purpose of the study five worksites were investigated, together with the plaster cast laboratory, the electromechanical workshop, the blacksmith forge and the dyer's shop.

The workers were classified according to the following homogeneous groups: marble artisans, conservers, mould-makers, technicians and engineers.

The risk factors identified were safety issues for work at great heights and the use of cutting and grinding machines in the workshops, noise, marble dust and manual handling.

From the results of the study several safety oversights and omissions were noted. According to industrial hygiene monitoring, almost all noise levels in the marble works exceeded 90 dB that is the limit value for an eight-hour exposure. Similarly the values for airborne dust at the marble laboratories exceeded the daily limit value. Given the fact that the concentration of crystal silicon dioxide (SiO2) in the Parthenon marble was determined to be 2.5 %, the limit value for inhalable dust was 2.2 mg/m3. There were no findings for BTEX compounds and metals in the dust (Ni, Cd, Fe). In all cases the relevant limit values were obtained from national legislation. The limit values set by the American Governmental Industrial Hygienists (ACGIH) were also considered as additional references (usually with lower limit values).

The risk for slips and falls was high since static friction was found on almost all worksites below the safety value set by the Americans with Disabilities Act and Architectural and Transportations Barriers Compliance Board.

With regards to the medical examination those workers with significant reduction in their acoustic ability (proportional to years of exposure) were the marble artisans. In Figure1 we can conclude that the group of marble artisans presents a significant reduction in acoustic ability in 2000 and 4000 Hz. The normal acoustic ability is around 0–10 dB.

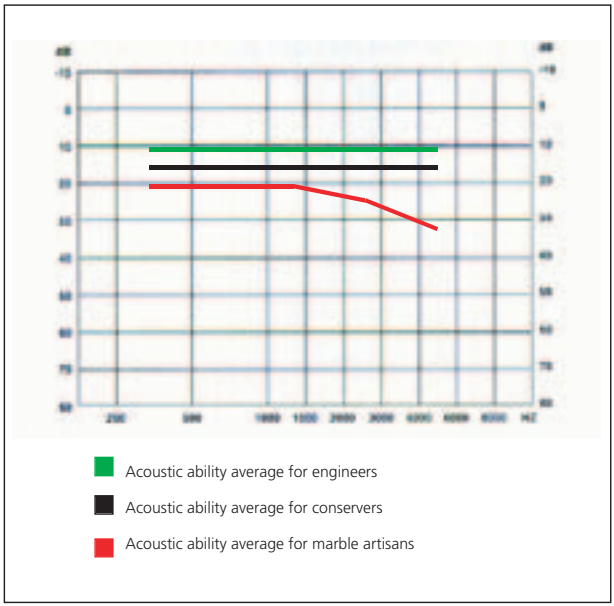


*Figure 1: Audiometry curves representing the acoustic ability of the groups of engineers, conservers and marble artisans*

Marble artisans manifested respiratory problems due to the exposure of particles and other airborne pollutants associated with the work environment.

At the end of the project, measures were suggested to YSMA to improve the safety and health of the workers. A special 'safety and health plan' and 'file' for restoration works were developed.

## Problems encountered during implementation

The main problems encountered during the study were the difficulty to change aspects of safety culture and inherent technical problems associated with archaeological monuments. For example, the erection of scaffolding was extremely difficult due to adverse conditions, namely the morphology of Acropolis rock and the position of Acropolis monuments.

Measurements on industrial hygiene were difficult to conduct since no vehicle could reach the Acropolis and all equipment had to be carried manually to the top. Another problem discerned was during the restoration works where the different types of activities and the pace of work varied from day to day. This made it difficult to record the actual risks.

Due to the historic nature and the artistic value of the Acropolis monuments the workers (supervisors, engineers, artisans) did not consider the restoration worksites as being hazardous since their attitude towards the work was more that of artists or sculptors. Any attempt to imbue YSMA with a new safety culture was difficult given the sense of priority they had towards the marbles. However, the results of the study alarmed YSMA enough to take action to improve health and safety.

Since YSMA at that time did not have a health and safety committee it was difficult to mobilise workers to participate in the study. For that purpose a general assembly was held with all workers aimed at informing them about the project and motivating them on matters of OSH.

## Results and evaluation of the action

A large number of employees participated in the study. This enabled the data obtained to be statistically significant. Most important is that the study actually paved the way to study the work conditions of conservers and maintainers of archaeological marbles and the associated exposures and risk factors.

Following an Elinyae evaluation of the impact of such activities on health and safety, YSMA is starting to apply some OSH measures. However, a great deal still needs to be done in this area. After the project more human resources on OSH were engaged for the restoration works (a new safety engineer has been appointed). Also a stricter PPE (personal protective equipment) policy has been applied. The safety culture seems to be changing in direction from top management to workers practices.

*Work on the historic Acropolis monuments*

As a follow-up to this study Elinyae, in conjunction with YSMA, is currently elaborating the Internal health and safety regulations concerning dangerous restoration works. On completion, a conference will take place to train employees of YSMA on the new policies and regulations.

Another positive outcome, although not planned, was that the Federation of Conservers in Greece, having been sensitised on matters of OSH by the study, requested the cooperation of Elinyae for further collaborative studies in other restoration works in Greece.

### Identified success criteria

The holistic approach to the problems of health and safety at the Acropolis site enabled Elinyae to properly integrate the safety and health issues that came to the fore.

The active participation of the workers was crucial to the success of this project.

### Is the action transferable?

This study was the first of its type to be conducted on an archaeological site in Greece. The methods involved in the study and its findings can be transferred to similar conservation and restoration works within Greece and Europe.

Also a model 'OSH plan and file' that was drafted for the purposes of the study can be used on other restoration works using similar techniques.

### Further information

Spiros Drivas
Occupational Physician
Head of Occupational Health and Industrial Hygiene Centre
Hellenic Institute for Occupational Health and Safety
43 Liosion & Theirsiou 6
GR-Athens 10445
Tel. (30-210) 820 02 01
Fax (30-210) 820 02 22
E-mail: spiros.drivas@elinyae.gr
Website: http://www.elinyae.gr