SEVENTH FRAMEWORK PROGRAMME
THEME 6
ENVIRONMENT
Grant agreement for Collaborative Project

Project acronym: ROCARE
Project full title: Roman cements for architectural restoration to new high standards
Grant agreement no.: 226898

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## LIST OF BENEFICIARIES

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**GENERAL INFORMATION**

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**Abstract**

Highly hydraulic binders, known as natural or Roman cements, were key materials to cover façades of buildings of the European Historicism and Art Nouveau (19th/early 20th century), a period of rapid urban growth in Europe. The maintenance, restoration and reconstruction of historic Roman cement façades form therefore an important issue in Europe’s efforts to preserve its architectural heritage. Therefore, the ROCARE project is proposed to provide conditions for the industrial development and commercialisation of Roman cements which is an innovative, promising technology developed at the level of a pilot-scale prototype in the recent research project of the 5th Framework Programme ROCEM, 2003-2006. The increasing awareness of the conservation profession and their interest in the product call now for further actions encompassed by the proposed ROCARE-project, which aim at filling gaps in knowledge and reducing the entry barriers of the novel technology to the market. They include (a) scaling up of the RC technology to a competitive level by optimising the process technologies at various conditions of production, (b) laboratory tests and studies to fully understand cement hydration and property development, as well as optimum conditions of mortar processing and handling in the conservation practice, and (c) broad dissemination measures to enlarge the market potential of the technology. The proposed project is designed for three-year duration and will be jointly conducted by 14 partners from industry, SMEs and research centres in 7 countries. It will allow the prototype developed in the earlier project to establish itself on the European market of building construction.
**Part B**

**B1 Concept and objectives, progress beyond state-of-the-art, S/T methodology and work plan**

**B1.1 Concept and project objectives**

**B1.1.1 Present situation**

Highly hydraulic binders, known as natural or Roman cements, were key materials to cover façades of buildings in the period of European Historicism and Art Nouveau (19\textsuperscript{th}/early 20\textsuperscript{th} century). This period of rapid urban growth still plays a major role in the culture and aesthetic appearance of central areas in most European cities. The maintenance, restoration and reconstruction of historic Roman cement façades form therefore an important issue in Europe’s efforts to preserve its architectural heritage.

The lack of Roman cements since World War II along with little knowledge about their historical background and their technical performance led to the use of improper binders for restoration purposes. In turn, this caused irreversible losses of the original historic substance, costly short cycles of removal and reapplying plasters, and an increasing burden on the environment because of the waste to be disposed. Hence, the preservation and restoration of the large preserved built heritage of European Historicism and Art Nouveau is still unsatisfactory.

As a result of the above situation, the ROCEM project was initiated and supported by the European Commission within the 5\textsuperscript{th} Framework Programme. Between 2003 and 2006, in over three years of intense research activities across the six participating countries, the manufacturing process of natural hydraulic binders possessing the characteristics and advantages of the historic Roman cements, has been re-established, and know-how has been re-gained. The study included:

- a thorough investigation of historic Roman cement mortars, in order to provide compatibility criteria for the new binders/mortars
- selection of appropriate raw materials
- determination of calcination parameters first in the laboratory and then in the pilot scale
- development of new mortars and comparison of them to ones collected from historic buildings
- evaluation of the developed mortars in workshop use and on-site conservation work, including full-scale restoration of the project’s reference building.

The research project was successfully completed, and the Roman cement and Roman cement based mortars developed by the ROCEM project are known to offer the following advantages:

- authentic historic material and technology compatible with the original mortars
- natural cement extending range of historic binders available for the conservation practice (lime $\rightarrow$ hydraulic lime $\rightarrow$ natural cement)
- colour matching the historic original
- universal binder enabling restorers to produce or restore a range of decorative elements on the façades of buildings
fast setting alumino-belite cement containing active aggregate yielding durable mortars
pure salt-free material
(mortars) combination of high strength with high porosity which assures good transport of water and water vapour

The dissemination of the Roman cement concept and the project results formed an intrinsic part of the ROCEM project and was successfully achieved through scientific publications, printing and distribution of brochures, national workshops and numerous contacts with representatives of all sectors involved. These activities continued after the end of ROCEM in 2006, when the concept had attracted considerable interest in Europe and even in the USA where requests have been made by the US Heritage Group, Inc for material to be used on their training courses. An increasing number of professionals from the restoration sector are now aware of the potentials of Roman cements and prepared to use these binders in their restoration practice or at least in trials. Advised by the ROCEM members, several restoration sites have successfully employed the cements:

- The Trade Academy of Krakow (PL)
- Façade ornaments of several buildings in Vienna (AT)
- The Freiburg Minster (DE)
- A large dwelling in Gothenburg (SE)
- A Royal Summer Palace at Oslo (NOR)

Due to the excellent potentials of the binder, a German supplier of specialised products for building restoration operating all over Europe, decided to add ready mixed Roman cement mortars to their range of products; the mortar was applied in one of the above projects (Freiburg).

In Poland, a national project following ROCEM has been focussing on issues important for the practical use of Roman cements in the restoration of building façades.

Eventually, application potentials of Roman cements outside the restoration area are emerging: in Austria, the guild of stone pavers expressed their strong interest in using Roman cement mortars for pointing purposes on roads and in pedestrian zones. There are also advantages offered by the rapid setting for the fixing of street furniture.

In accordance with the ROCEM standards, the Roman cements used by the above projects were produced partly by the ROCEM consortium and partly by a small company instructed by ROCEM but with no policy of regular cement manufacture.

In view of the facts described above, the market potentials of Roman cements in Europe are not yet fully exploited. The main reasons for this shortcoming are evident:

- The industry is hesitating to manufacture Roman cements because of a gap in knowledge of how to transfer the technology of production to the industrial scale, and because of a certain lack of confidence in the market
- The market, in turn, needs more data about the cement’s performance under standard and real conditions over a wider range of mortar compositions.

To create all conditions needed to establish Roman cements as a fully competitive product on the market has been clearly beyond the scope and beyond the capacity of the ROCEM project.
From a purely scientific viewpoint, no complete understanding of all processes involved in the hydration of Roman cements was achieved. However, ROCEM has developed, tested and applied technologies at the level of a laboratory and pilot-scale prototype production of Roman cement, and thus achieved a level of technical and scientific knowledge as well as a product identity good enough to perform the ultimate step towards a marketable product.

B1.1.2 Competitive advantages and unique selling points

The advantages of the historic Roman cements and their modern analogues have been published elsewhere and can thus be summarised in short:

- Low energy consumption because of low temperatures of calcination (ca. 800 – 1,100 °C)
- High durability even at high levels of air pollution
- Excellent compatibility with historic building materials
- Wide range of mortar recipes and of application techniques

In contrast to Roman cement, there are shortcomings of the binder products so far applied in the restoration of 19th and early 20th cent. buildings which were not only identified by the ROCEM project but had been already known to exist before:

- Portland cements are not compatible because of their aesthetical and technical performance and are therefore rarely accepted by the heritage community – they yield materials which are too strong, brittle and lacking in breathability in comparison with the original Roman cement mortars; mixtures with lime are just a secondary choice.
- So-called belite cements which may have seemed similar in silicate composition to Roman cements behave totally different in terms of workability and strength development – it was understood that the reason for this lies in the sometimes higher temperatures of calcination of a belite cement together with their lack of a significant aluminate phase.
- Limes and hydraulic limes, frequently applied in the restoration of historic buildings, do not perform in an appropriate way as to their workability and durability, especially when applied on Roman cement façades.
- Natural cements – the family Roman cement belongs to - are rarely produced – at present, there is just one European product which probably does not fully match the historic Roman cement.

Thus, it can be stated that the authentic Roman cement re-established by the ROCEM project under the patronage of the European Union forms the only historically accurate replacement for the restoration of Roman cement decorations of historic façades. It possesses all features of the historic Roman cements which made them favoured materials for economic, aesthetic and highly durable decorations for the exterior of buildings.

B1.1.3 Main objectives of the proposed project

Based on the situation, the main aim of ROCARE is to make Roman cements become a competitive and highly demanded, as well as a compatible and sustainable product for the restoration market in Europe.
This requires the combination of fundamental and applied research in order to:

- develop the prerequisites of the industrial production of Roman cements according to the specific needs and expectations of the cultural heritage market
- fully understand all chemical and mineralogical processes occurring in the course of the Roman cement hydration at well controlled standard conditions
- involve the specific demands of end-users in order to establish the best performance of Roman cement mortars at real conditions encountered in the practice of application, for the sake of clear advices of mixing and handling of these mortars in observance of the specific conditions of a site
- test and demonstrate the effectiveness of the technology on sites
- create all necessary conditions to establish Roman cements as marketable building materials mainly for the restoration of architectural heritage
- identify additional possibilities to employ Roman cements in other sectors of construction and thus create new markets

B1.1.4 Concept and structure of the proposed project

According to the main objectives listed under 1.1.3, the proposed project relates to the topics of the call, namely to focus on “innovative technologies at the level of laboratory or pilot-scale prototypes but still requiring further testing, validation and engineering for operational use and subsequent commercialisation“.

The concept is based on the collaborative action of different groups of partners from several European countries. The groups are:

- Producers of Roman cements
- Scientific units
- End users
- Institutions regulating issues of application (this group will not participate but form an advisory panel)

The producers group – companies strongly differing in their size, technical premises and commercial policies – will produce and optimise production of Roman cements, wherever needed advised and assisted by the scientific units group. This part of the project will enable transfer of the cement technology to a competitive level. This group will expand the range of both production technologies and the source of suitable feedstock.

The scientific group – public and private laboratories - will use the cements to study their performance under standard laboratory conditions as well as in respect to “real-life” requirements, defined by the active participation of the end users and the regulators. This part of the project will deepen the understanding of the processes involved in the use of Roman cements and give clear technical advices on how to design, mix, process, apply and cure Roman cement mortars for the various fields of application.

The end user group - restorers together with an SME specialised in the formulation, distribution and application of restoration products - will address the specific demands related
to the practical use of the cements and test them by producing mortars and applying them in laboratory and on-site trials. In addition, the above mentioned SME will act as a multiplier of the technological concepts achieved.

The regulating institutions - conservation authorities at various levels, i.e. national, regional or municipal, will ensure good communication between the project team and the potential end-users to identify problems and research priorities, and thus help minimize barriers preventing the use of the Roman cement technology. In addition, they will facilitate local conservation projects to be carried out by the end user group.

The overall concept of the proposed project is shown diagrammatically later in Section 2.

**B1.2. Progress beyond the state-of-the-art**

**B1.2.1 State-of-the-Art in respect to Roman cement prior to the ROCEM project**

Roman cements were natural, highly hydraulic binders, produced from marls – limestones containing clay. This natural combination of calcareous and argillaceous matter required only calcination (800 – 1200 °C) - below the sintering temperature - and subsequent grinding to produce a binder of remarkable strength and durability. The success of the cement synthesis in shaft kilns at low temperatures resulted from the natural intimate mixture of lime and clay in the marl, which could not be attained in any man-made mixture. For this reason, at least in the historic context, Roman cements were inevitably “natural cements”.

Roman cements can be placed between hydraulic limes and Portland cements in a continuum of hydraulic binders. They differ from hydraulic limes in that they are not high in free lime and therefore require grinding rather than slaking to achieve a fine powder. They differ from the Portland cements by the different chemistry resulting from considerably lower calcination temperatures.

They have fast setting times after the addition of water. The development of strength in Roman cement mortars is particular: after rapid setting, the increase in strength is relatively slow but, after several months, compressive strength values similar to, or even above, those of contemporary Portland cements are recorded.

These features, as well as their warm yellow-to-brown colour, made Roman cements favoured materials for economic and easy manufacture of stuccoes for the exterior of buildings, highly recommended in contemporary technical literature and textbooks for stuccoists.

The Austrian Standard of 1880, modified in 1890, specifies the range of setting times which facilitated the choice of a suitable material for a given decorative task: ‘Roman cements bind fast, medium and slow. By fast binding cements one should understand those which with no addition of sand start to harden within 7 minutes from the moment water is added. Roman cement is considered a slow binding variety if hardening starts later than after 15 minutes’.

Other features specified by the standards are: volume consistency under water and in air, fineness of grinding, as well as tensile and compressive strengths for various cements and ages, quoted in full in Table B1.2a.
Table B1.2a: Strength specifications for Roman and Portland cement mortars as given by the Austrian standards of 1878 and 1890

<table>
<thead>
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<th>Age</th>
<th>Tensile strength [N/mm²]</th>
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<tr>
<td></td>
<td>Roman cement</td>
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</tr>
<tr>
<td></td>
<td>Quick ≤ 15 min</td>
<td>Slow &gt; 15 min</td>
</tr>
<tr>
<td>7 d</td>
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<td>≥ 0.5</td>
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Suitable marlstones, which were exploited for Roman cements, could be found in different geologic formations. The marlstone was crushed to lumps and mostly fired in shaft kilns of varying types and sizes. The usual fuel was coal, coke, wood or turf. It was generally agreed that the calcination of marls to produce Roman cements should be conducted at ‘low’ temperatures. Unable to slake in contact with water, caused by its lack of free lime, the calcined material, the Roman cement ‘clinker’, had to be ground to a fine powder. Then it was packed usually into 250 kg barrels or 60 kg sacks and shipped by rail or river.

The first Roman cement was patented in 1796 by James Parker in England, where it was used in construction where masonry was subjected to moisture and high levels of strength and durability were needed. It also became used for rendering façades of buildings. While the use of Roman cements in the UK gradually declined in the latter half of the nineteenth century, its production quickly increased in the mainland Europe. The use of Roman cements gradually declined in the twentieth century, being displaced by Portland cement, which came to dominate the market. Figure B1.2a illustrates the tendency by showing the use of Roman and Portland cements in Austria-Hungary in the nineteenth and early twentieth centuries.

Roman cement stuccoes are generally very durable. Fine surface cracks, forming an irregular network not related to building features, are a distinct characteristic of all Roman cement.
renders and architectural castings. They are caused by normal drying shrinkage and usually do not lead to damage. Hollow sounding areas, indicative of a loss of bond, are always present but lead, exceptionally, to losses only when water is freely admitted and trapped between the stucco and the wall.

An improper maintenance, making the stuccoes vulnerable to chronic excessive dampness, is a far more frequent cause of failure. The main conservation problem, however, is the later repair and renovation measures irreversibly altering the original surfaces. Few materials have been so little appreciated and treated as Roman cement stuccoes. Years of neglect, the accumulations of paint layers or sprayed cement coatings, damaging cleaning and patchy repairs with improper materials adversely affect and aesthetically degrade a substantial part of the nineteenth and early twentieth century built heritage. Original renders and decorative castings are often removed when in poor condition rather than conserved or replaced. Once removed or irreversibly coated, the important information on past aesthetic concepts, technology and building skills is lost for good.

The nineteenth and early twentieth century buildings deserve the same good conservation approach as objects from earlier periods. One of the fundamental principles of modern conservation is that the historic buildings should be repaired by using materials which are compatible with the original historic substance. Ignoring this rule brings negative consequences and frequently a quick progress of deterioration.

A good illustration of the problem is the use of Portland cement based mortars and renders for repair of historic buildings. Cement mortars are compact, ‘non porous’, impermeable to water vapour, rigid and often too strong compared to the brick substrate they cover. Cement renders can crack eventually allowing water into the wall with no ability for the water to evaporate. This leads to moving the zone of deterioration, caused by high moisture content and crystallisation of salts, deeper into the wall with disastrous progress of damage.

The negative experiences of the past have brought a renewed interest in use of lime mortars for conservation, an increase in the production of suitable materials as well as reintroduction of historic application and craft techniques. As a result, a rich spectrum of pure and natural hydraulic limes are now available on the market, which makes possible satisfactory conservation and restoration of the historic architecture in which lime mortars were used.

Unfortunately, prior to the implementation of the ROCEM project, a totally different and unsatisfactory situation prevailed in the field of the restoration of the massive built fabric of the nineteenth and beginning of the twentieth centuries. The lack of Roman cements deprived the restorers and the building contractors of the possibility to implement the principal rule of using the original technology for repair and reconstruction. They were forced to use unsuitable materials usually based on Portland cements. As already mentioned, the Portland cement repairs produce unsatisfactory technical and aesthetic results. One of the further negative aspects was the necessity to cover the repaired façade with a layer of modern paint which forever hid the primary aesthetic appearance of the building.

B1.2.2 State-of-the-Art established by the ROCEM project

All of the relevant results produced by the ROCEM project were summarised in the reports and published in journals (Weber et al 2007a, b, c; Vyskocilova et al 2007; Hughes et al
2007a, b, c). Below is a critical compilation of the results which, as a matter of fact, gave significant contributions to the state-of-the-art.

B1.2.2.1 Historic mortars

As a rule, historic Roman cement mortars contain a significant amount of binder nodules which were identified as un-hydrated or less reactive clinker relicts. Their thorough analysis was not only the key to the knowledge of the original clinker compounds, but also helped to understand that typical Roman cement was a mixture of differently reactive components as a consequence of the unequal conditions prevailing in the process of calcination. The nodules were recognised as a factor contributing positively to the mortar properties. In all of the cements produced by the different processes described below, similar features were obtained.

It is not yet investigated, however, to which extent the binder nodules would form in all types of modern production processes. This question, along with the aspects of various grinding sizes of the cements, will have to be researched in the proposed project.

The measurements of the physico-mechanical properties of historic Roman cement mortars revealed some surprising results which make Roman cement mortars a unique material: relatively high compressive strength usually goes along with high porosity and water absorptivity (Table B1.2b).

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B1.2.2.2 Raw materials and cement calcinations

Based on the rich information found in the 19th cent. textbooks on Roman cements as well as on the analytical data obtained for historic mortars and on today’s state-of-the-art in modern cement technology, the ROCEM project has researched the best conditions to manufacture Roman cements in the sense of the historic material.

The Roman cement (RC) production process developed by ROCEM differs in two principal aspects from the Portland cement (PC) manufacturing process – firstly, the use of a natural stone as raw feed for RC, and secondly the low kiln temperatures of about 900 °C as opposed to PC. This results in a different mineralogical composition of both types of cements, giving rise to a range of differences in their technical profiles.
Several key requirements for a marl to be suitable for the production of a Roman cement were identified:

- oxide composition corresponding to the values of the Cementation Index (CI) falling between 1.0 – 2.0, CI being calculated using the formula:
  \[ CI = \frac{(2.8\times \text{SiO}_2 + 1.1\times \text{Al}_2\text{O}_3 + 0.7\times \text{Fe}_2\text{O}_3)}{(\text{CaO} + 1.4\times \text{MgO})} \]
- sufficient amount of clay minerals as the main source of silica and alumina together with their particular mineralogy
- petrographic fabric of sufficient fineness and intimate mixture of clay, quartz and calcite
- porosity of the marl.

In spite of the above rules, the ROCEM project had to face the fact that Roman cements at their time were produced from different source materials that nature provided. The exact conditions of their calcination were therefore established by each production site on a merely empirical base, and the key properties - setting time, strength development and colour - were very sensitive to the choice of raw material and the calcination conditions. Careful laboratory calcination was undertaken by ROCEM in order to not only identify the appropriate calcination parameters for a given marl but in addition create a methodical tool to optimise the calcination conditions for each single source of raw material. This approach was based on laboratory test calcinations at varying temperatures and residence times.

Figure B1.2b illustrates the approach used to identify the optimum conditions of calcination for a given marl.

![Paste Strength (MPa) / PL-F104 / 4 weeks](image)

The above described approach was used for a number of raw materials, most of them of historic relevance as cement stones. In addition to the criterion of paste strength at 28 days as shown in the graph of Fig. 3, other criteria were used to find the best conditions, such as e.g. the time of setting, the early strength and the soundness under water.

For an average marl, the calcination parameters were found optimum as follows:
• calcination temperature at 800 – 850 °C
• calcination process time of 300 – 600 minutes

The optimum temperature of the above range was surprisingly low. Over-burning was shown to yield inferior cements. This result is of high novelty and relevance to the whole field of cement research.

The optimisation programme conducted by ROCEM was necessarily performed on a laboratory scale, starting with a small electrical kiln. However, at an advanced stage of the project when larger amounts of cement were needed for trials, a specially constructed flat bed kiln was employed. Towards the end of the ROCEM-project, a small rotary kiln was used to produce the necessary quantities of Roman cement. The quality and consistency of the cements were always followed by the relevant tests and analyses. The resulting cements were used to prepare mortars which were successfully employed in laboratory tests and on-site restorations.

In parallel to the transfer from a laboratory kiln to a rotary kiln, a number of very promising calcinations were performed in a small, self-made shaft kiln heated with timber. The Roman cements thus produced were eventually used on restoration sites but not fully assessed for their composition and properties.

The above developments marked an important step of transferring the technology towards modern industrial premises on the one hand, and towards low-cost alternative ways of production on the other hand. The progress achieved by ROCEM was beyond the expectations, but is, nevertheless, not sufficient to start with the productions of Roman cements on a competitive industrial scale. This gap is to be bridged by the proposed project.

As a function of the degree of calcination, the mineralogical composition as well as the microstructural features of the Roman cements were studied – both parameters are of utmost importance for the cement properties. The results, presented e.g. in (Weber et al., 2007a), are exemplified by Figure B1.2c: several reactions take place on calcinations of the marls: the decomposition of calcite to lime, the dehydration and decomposition of clay minerals to ill-crystalline or amorphous aluminosilicates, and the reaction of lime with quartz and decomposition products of clay minerals to give dicalcium silicate – belite as a mixture of two structural modifications alpha’ and beta and, at higher temperatures, calcium aluminosilicate - gehlenite. As the calcination is increased, the calcite, quartz and amorphous contents decrease; the free lime increases to a maximum before decreasing; the gehlenite increases; the total belites increase but with alpha’-belite dominating at low temperatures before transforming to beta-belite with an increase in temperature.
From a micro-structural point of view, increasing temperatures result in bulkier reaction products which, for a given component, are less reactive than the fine ones formed at optimum conditions.

Phase composition and petrographic features of a Roman cement were hence largely understood at its sub- and super-optimum resp. optimum conditions, even though an exact characterisation of the ill-crystalline portions of the cements still requires further substantial investigation.

B1.2.2.3 Hydration and strength development; mortar properties

The ROCEM research found that the hydration of Roman cement proceeds according to a two-step mechanism which is reflected by the curves in Figure B1.2d:

- Step 1 - rapid set and hardening after mixing with water; unlike Portland cements, Roman cements harden within a few minutes after the initial set. Early strength development correlates with the formation of calcium aluminate hydrates (C-A-H). Strengths of at least 4 MPa (w/c 0.65) were attained at the earliest test age of 6 hours for the best cements.

- Step 2 - After a varying dormant period, further strength development proceeds due to the hydration of belite, alpha’-belite being more reactive than beta-belite, yielding calcium-silicate-hydrates (C-S-H). The length of the dormant period is a function of calcination temperature and marl characteristics; its cause remains to be clarified. Late strength development continues for several months and may lead to high final strength values – for high quality Roman cements 20 MPa (w/c/ 0.65) at an age of 6 months should be attained.

Despite the general validity of the above model, it became clear that Roman cements obtained from different raw materials follow different paths of hydration, as reflected by the deviations of the curves in Figure B1.2d. Thus, some important questions relevant for the production and use of Roman cements were not fully understood and should be further studied. They will be addressed by the present proposal.
The time of setting may be extended to between 15 min to 40 min by admixing small amounts of appropriate retarders such as e.g. citric acid. Other possible retarders include potassium citrate, and molasses. However, trials in the post-ROCEM period suggest that some retarders may not be universally applicable and therefore a full range should be tested and assessed for their impact on the mortar properties so that conservators may use the material with confidence.

The microstructure of hardened Roman cement indicates a dense C-S-H gel. Mercury porosimetry determined average pore diameters of around 20 nanometres. An additional significant pore size maximum in the range of 0.1 … 1 µm may be present and was proved to contain important information on the curing conditions of a mortar.

In contrast to Portland cement, historic Roman cement mortars exhibit a high water-accessible porosity ranging from 20 – 40 % which assures good transport of water and water vapour. The specific properties of hydrated Roman cements correlate well with the observed high durability of Roman cement stuccoes and renders.

The ROCEM team acknowledges that the properties of the new cements and mortars have been established under ideal standard laboratory conditions whilst those of the historic mortars were obtained from decorative elements applied to porous substrates and subject to variable curing. It is necessary, therefore, to bridge this gap which is a key objective of the proposed project.

B1.2.2.4 Résumé of the state-of-the-art after the ROCEM-project

The ROCEM-project has yielded good knowledge of:

+ Composition and properties of historic Roman cements and mortars
+ Typical nature and range of compositions of raw materials
+ Range of calcination temperatures and residence times at laboratory scale
+ Mineral composition and petrographic nature of cement clinker
+ General path of hydration and strength development at laboratory conditions

Only **incomplete information** was obtained for:

- Parameters of cement calcination at industrial conditions
- Impact of grinding size and of mixing ratio overburned/underburned clinker on cement properties
- Range of possible retarders and their impact on mortar properties
- Path of hydration and property development at real conditions; possibilities of repeated re-hydration over prolonged periods of time
- Complete model of hydration
- Some mortar properties, e.g. breathability factors

### B1.2.2.5 A new approach

Of necessity, the ROCEM project was internally driven in its approach to re-develop Roman cement mortars. By this we mean that, whilst the consortium had considerable expertise of the conservation market within its membership, it did not directly seek the views of bodies such as national heritage organisations to guide the work. The proposed ROCARE project will commence with a greatly enhanced knowledge base and will actively seek the demands of such organisations such that they provide the framework for the research effort. In this way the objectives of B1.1.3 will be met and Roman cement will move from the pilot scale to successful commercial application fully confident that the precise needs of the community have been addressed.

### B1.2.3 The Market for Roman Cement

#### B1.2.3.1 Background

The buildings of European Historicism and Art Nouveau, especially representative large public buildings as well as whole urban spaces including avenues and squares, have become landmarks of the European cities. They shape city landscapes, ensure urban identity and become places that tourists and local communities value and want to visit, where new activities appear. Cultural tourism and local communities, however, need authenticity. Hence, particular attention is given to conservation of the heritage resources in question so far underappreciated and viewed as disposable. The architectural surface as an inherent historic and aesthetic part of the building is becoming at present more and more appreciated; hence, the authenticity of the surface is increasingly valued by both European Heritage professionals and the general public, and provides a distinct driving force for demand for Roman cements, key materials for proper restoration of historic buildings.
B1.2.3.2 General market outlook

The demand for well-designed restoration is potentially very considerable, taking into account the rapid expansion of the cities at the period concerned, in line with the Industrial Revolution. However, exact statistics are not available, and only an estimation can be made. An authoritative report on cultural heritage policies in Europe provides numbers of listed ‘monuments’ in 27 European countries and the funds (financing) made available by the authorities for the conservation and restoration of these monuments. From this report one can derive that there are about 1.7 million listed ‘monuments’ in the EU and that the total annual budget is on average in the order of € 8.5 Billion.

Another report by UEAPME on ‘job creation potential in the restoration of cultural heritage’ estimates the number of important historic monuments in Europe at 2.5 million. Moreover it concludes that there is building stock requiring protection which is 10 times larger than this. Most of this massive built heritage dates from the 19th century in which Roman cements were widely used.

The above data can serve as a first estimate for the size of the market. The addressable market size can be calculated from the estimated number of monuments that have been manufactured from Roman cement.

From the contemporary literature (A. Tarnawski, 1887) it can be calculated that in the Austro-Hungarian Empire of 1887 the production of Roman cement as compared to Portland cement and hydraulic lime, respectively, was in the ratio 5:1:1. In other words: 5/7, or about 70%, of the constructions from that period used Roman cement. This impressive volume may be highest in the Habsburg area, but it gives some idea about the range of importance of Roman Cement in Europe in general.

The addressable market can now be estimated with following assumptions.

- As a conservative estimate, spending of private owners on building restoration is in the same order of magnitude to the spending of public authorities, giving a total spending of € 17 Billion on restoration of cultural buildings.
- A second assumption is that about half of the historic buildings from the 19th / early 20th century require protection.
- Restoration of buildings is a craft business which requires highly-skilled labour, requiring talent and experience. Consequently, restoration companies are by default small-sized and dispersed over Europe. Also, usually only a small percentage of the expenses for the restoration of the building is spent on the purchase of the materials. An accurate estimate cannot be made, unfortunately, given the large variety in restoration objects and restoration tasks to be done. Having said this, restoration experts estimate the material expenses in the range of 7-20% of a project. Therefore, an estimate of 10% seems a reasonable estimation for the purpose of our calculation of the market size.

Based on these assumptions, the annual addressable market for Roman Cement can be estimated as ~€ 600 Million (€ 17 Billion x 50% x 70% x 10%). Obviously, this figure is not more than a first indication, but because this figure is derived from conservative assumptions, it is clear that the market for the use of Roman cement is considerable.
As an interesting addition, the use of Roman Cement is not limited to historical buildings; it can also be used in modern buildings, since there are several advantages over modern cement. This implies that the exploitation potential of these Roman Cements is even better than indicated above, although it remains difficult to calculate it more exactly.

B1.2.4 Market Introduction Plan

The ROCEM project ended with several achievements confirming the feasibility of the transfer of the Roman cement production from experimental to commercial conditions:

- the extensive laboratory studies showed that the cements developed are of high quality and unique in their material properties that mimic the original Roman cements very accurately
- estimated 5 tonnes of optimised cements were produced in the pilot-scale kiln
- the feedback from the conservators using the cements was positive.

Therefore, a detailed Technology Profile combined with a Business Package was elaborated in the final phase of the project to present market opportunities in a concise document, taking into account technology assessment, market prospects, perspectives of potential profitability, investments, return on investment, risks and legal aspects. The document was prepared by project’s subcontractor Henk van Ekenburg of Pro Support B.V., the Netherlands, basing on the information gained during the project.

The Business Package has identified the following key aspects of the market introduction plan:

- **a considerable potential market** for re-established Roman cements has been identified. The calculations, based on the estimated number of monuments, public and private spending on the building restoration and percentage of restoration costs spent on conservation materials, are quoted above in part B1.2.3.2

- Roman cement should be primarily positioned in the market as a high-quality, **specialised material for restoration** which is compatible and historically accurate replacement of the historic binders and therefore meets fundamental requirements of the conservation formulated in important normative documents like the Venice Charter of 1964.

- The product should be initially positioned at the **high end of the market**, only open for purchasing by qualified restoration professionals. This will ensure that the material will be used for appropriate applications and not to unsuitable buildings or in an improper way, which might adversely affect the perception of the material quality, leading to an undeserved market failure.

- Only in a longer perspective, the binder can be considered also as a **building material for new building**; once its performance is recognised by the construction sector, new market opportunities can emerge.

- The distribution should be best placed in the hands of a reputable, well established European companies, already selling a wider range of products to restoration companies, with a special focus on conservation, repair and maintenance of historic buildings, which would be capable of providing a **high-level support service** in how to apply the Roman
cement to the targeted customers, including project-specific customized solutions for the
tasks at hand, when appropriate.

− **Uncertainty whether the technology works** was identified as a major market entry
barrier. Indeed, when historic binders, by definition of varying composition and technical
parameters, do not deliver the desired results, the costs spent on restoration are wasted or
worse the material may cause a detrimental effect on the building. Previous experience
with the introduction of new materials for conservation purposes has shown that opinion
about a novel technology is formed very slowly.

− Getting Roman cements from the Early Market (high-level conservation professionals) to
the Mainstream Market (restoration and construction sector) was regarded as key to
**successful market diffusion**.

There has been a very positive development in the market penetration after the end of the
ROCEM project in 2006, when the re-established Roman cements had attracted considerable
interest in Europe and even in the USA. An increasing number of professionals from the
restoration sector have become ‘technology enthusiasts’, aware of the potentials of Roman
cements and prepared to use them. Several restoration sites have successfully employed the
cements; optimistically, the applications have become independent of the advice and
couragement of the ROCEM team.

Therefore, the present consortium implementing ROCARE seeks to expand the available
Market Introduction Plan in several key areas:

- structure of the Mainstream Market in the building restoration and general construction
sector will be analysed more in detail and the best strategy to penetrate this market will be
proposed. This extension and updating of the Market Introduction Plan will be carried out
by a subcontractor “Peter Butz – Handelsvertretung für bauchemische Produkte und
Bauphysik” from Neuenrade in Germany which has a long experience in the product
marketing and application in the building restoration sector. The work will be carried out
at the initial stage of the project and the document will be ready within first 3 months of
the project’s duration.

- attempts will be undertaken to overcome the main market entry barrier - uncertainty if
Roman cement is a uniform, high-quality material with consistent technical characteristics
making it different and superior from other binders used in the building restoration – by
preparing detailed technical specifications which will provide criteria against which
Roman cements can be positioned as a unique product and their quality can be assessed.
Measures aimed at the implementation of these technical specifications and guidelines for
the proper application of Roman cements into a European standard within the activities of
Technical Committee 346 ‘Conservation of Cultural Heritage’ of the European Committee
for Standardization CEN will be undertaken. This will be facilitated by a direct
participation of experts of the project consortium in the activities of this CEN Technical
Committee.

- the market implementation plan will be consulted and optimised by the End User
Advisory Panel consisting of approx. 20 representatives of conservation authorities which
are institutions regulating and controlling the restoration process at various levels –
national, regional or municipal. The Advisory Panel will meet at the outset of the project
to identify barriers preventing the use of the Roman cement technology, and to give opinions, expectations and recommendations of the end-users.
References


B 1.3  **S/T methodology and associated work plan**

B.1.3.1  **Overall strategy and general description**

The project duration will be 3 years. The project is structured according to Figure B1.3a. It will operate through 4 Work Packages according to the different thematic focuses (see also Table B1.3a). They are:

**WP 1 – “Manufacture of Roman cements”**

**WP 2 – “Optimisation of handling cements and mortars”**

**WP 3 – “Dissemination and marketing”**

**WP 4 – “Management”**

**WP 1** will be based on a successful prototype and a relatively simple process technology. The aim of technology transfer can be achieved by adaptation of the process to the technical and logistic premises of the producers.

Based on a short stage of analysis of the raw materials and lab tests to ascertain their optimum conditions of calcination, the necessary parameters for the pilot production of Roman cements by the companies will be defined (milestone 1). This will be conducted in an iterative process using basic methods of quality check to immediately correct and improve the process. At latest about half year before the end of the project, the pilot stage will be concluded and all outcomes will be discussed in a project meeting which will also present and discuss the results produced in WP 2. This meeting will set the milestones 3 and 4 decisive for the final implementation of the project outcomes. The final stage will see the serial production of Roman cements still in the frame of the project which will thus provide all necessary means to assure the best possible start of the new Roman cements.

The internal structure of WP 1 is such that the three producers will use different technologies and will therefore work in parallel, with a maximum of exchange of knowledge but probably without any mutual interference. The scientific partners will assist where necessary. No significant risk is expected in this workpackage.

**WP 2** will act as the central work package between production and marketing in the following ways:

- Continuous feedback to WP 1 on the quality and product adequacy of the Roman cements. Leading far beyond the standards of a usual quality test, these activities will comprise a number of instrumental analyses and tests needed for a full understanding of all processes and mechanisms involved in the hydration of Roman cements.

- Further on, in order to keep track of the user market’s request, the exact content of the workplan within this workpackage will take into account the outcomes of a number of important activities, particularly a meeting of the End-User Advisory Panel (see WP 3) which will serve as platform to identify the users’ questions of interest. This will substantially contribute to define (milestone 2) the focal points for the optimisation of application techniques of mortars, a study that will be continued for the following 1.5
years, testing and measuring mortars in the lab as well as on-site leaving only long-term
tests to be completed in the 3rd year of the programme. Compatibility, a complex item of
utmost importance, will form a key aspect of this study.

- Both scientific programmes described above will operate in an interconnected way. They will use the prototype Roman cement from the ROCEM project as well as the only competing natural binder at present, i.e. Prompt cement by Vicat, Grenoble. At a later stage the new Roman cements produced in WP1 will be included in the tests.

**WP 3** will comprise activities related to marketing and promoting of the Roman cement technology. All relevant activities such as workshops and lectures, production of product sheets and manuals in printed and electronic forms, a project website etc. will be allocated in WP 3. Thus, national workshops at the end of the project will be organised, as well as an international conference as important side-event to the meeting at PM3; further, demonstrations of the Roman cement technology in the lab and on site, and various restoration works using the Roman cements on buildings and façades will be performed. All this will be done with substantial input of an End-User Advisory Panel representing conservation authorities at various levels, to be installed in order to identify problems and research priorities and to help develop the optimum solutions from the perspective of the conservation practice.

Another important aspect within WP 3 will be editing of a Manual on mixing, handling, applying and curing of Roman cement mortars. This booklet will be designed in a way to best advice and attract the end-user group.

**WP 4** will ensure optimum management of the project through the whole duration and will continue to operate if needed after the end of the project.

The below diagram explains the structure of ROCARE.
B.1.3.2 Timing of work packages and their components

The below chart shows the timetable of the ROCARE-project

B.1.3.3 Work package list /overview

<table>
<thead>
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<tbody>
<tr>
<td>Workpackage title</td>
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### B.1.3.5 Work package descriptions

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**Objectives:**
Transfer the technology of Roman cement production to the industrial level considering different company profiles of potential producers

**Description of work:**

**Task 1.1: Identify and check appropriate raw materials for Roman cement production**

The raw materials will be selected according to the specific conditions of the cement producing partners:

- Marl from a company source in Wietersdorf (AT) – partner WP
- Marl from a recent cement stone quarry in Folwark (PL) – partner MBM
- Marl from a historic Roman cement stone quarry in Kufstein (AT) – partner VFB

Chemical, mineralogical and petrographic analysis of the raw materials will be performed using oxide analysis, XRD, thin-section microscopy and SEM

Advice on the calcination of the marls will be provided based upon the knowledge gained in the ROCEM project. Mineralogical analysis of trial calcinations will be compared with those of existing high quality cements

1.1 will define materials and general process parameters in Deliverable D 4, being decisive for the following steps = milestone 1

**Task 1.2: Calcination and grinding of Roman cements – pilot stage**

The raw materials checked in 1.1 will be employed to produce Roman cements, using the kilns of the producing partners, i.e. a modern shaft kiln, a Lepol/rotary kiln, a small pilot rotary kiln, and a small traditional shaft kiln. This stage of the project is decisive; it will most probably follow an iterative path of optimising the process by using methods of quality check of the cements produced (see Task 1.3). Once an optimum product has been achieved (Deliverable D 6), it will be used to optimise further process steps (see Tasks 1.4, 1.5)

**Task 1.3: Quality check of Roman cements**

The cements produced in 1.2 will be checked for basic properties according to the state-of-the-art, such as time of set, mortar strength at various ages, and soundness under water. Wherever possible, this will be done in the laboratories of the producing partners; otherwise, it will be outsourced to a specialised lab nearby.

**Task 1.4: Optimisation of further process steps**
For good cements according to 1.2 and 1.3, additional tests will be performed. They will e.g. use separated portions of distinctly different degrees of calcination from single firings or from separate firings, respectively. The will also use different sieve fractions of the cements. Quality criteria are again those listed under 1.3. The results will describe full process cycles leading to optimum Roman cements (Deliverable D 7)

**Task 1.5: Characterisation of optimum Roman cements**

Using XRD, DTA-TG and SEM/EDX, the optimum Roman cements will be characterised for their chemical-mineralogical composition (Deliverable D 10). (Their paste and mortar properties will be assessed in WP 2)

**Task 1.6: Providing the partners with sufficient Roman cements**

Several tons up to tens of tons will be needed for tests, measurements and demonstration works in the laboratory and on-site; they will be produced within one or 2 firings.

1.1 to 1.6 will define materials, processes and parameters decisive for the serial production of Roman cements – milestone 3

**Task 1.7: Roman cement production for the needs of the market**

**Deliverables:**

- D 4 Data on appropriate raw materials and their optimum calcination temperatures
- D 6 Roman cements produced through optimum pilot calcination processes
- D 7 Set of parameters describing optimum process cycles for Roman cement production
- D10 Set of data describing chemical-mineralogical composition of optimum Roman cements
- D13 Roman cements in amounts sufficient for lab and trial testing and for demonstration
### Description of Work Package 2

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**Objectives:**

1. Full understanding of all processes and mechanisms involved in the hydration and strength development of Roman cements
2. Evaluation and assessment of the best practice in mortar application, considering conditions frequently encountered in the restoration of buildings and including various aspects of compatibility

**Description of work:**

**Task 2.1: Improving knowledge of hydration mechanisms**

The research will be performed using prototype cements from the former ROCEM-project, cements produced within WP 1 of the proposed project, and a product by Vicat, France, merchandised under the brand name of Prompt-Roman cement.

The aim is to establish the influence of the specific composition of a Roman cement and the parameters of its manufacturing – raw material preparation, calcination, cement grinding and conditions of storage – on the setting and on the overall performance of the cement, including possibilities of the re-hydration during repeated rewetting.

The laboratory work will comprise the following analytical steps:

- **Chemical analysis** of the raw materials and the cements produced, using wet chemical analysis and RFA
- **Hydration studies**, using QXRD, in-situ XRD, DTA-TG, DSC, solid state pH-measurements and resistivity measurements on hardened cement pastes and mortars; studies on carbonation and water transport; studies on the control of setting and the influence of the exact raw material composition
- **SEM-EDX** and **ESEM**, to explain the hydration at various stages in terms of the microstructure of the paste
- **Hg-porosimetry** to follow the hydration at various stages in terms of the pore size distribution of a paste
- In parallel to the analyses listed above, all relevant mechanical parameters will be assessed at different ages of a paste, i.e. compressive and tensile strength, static and dynamic elastic moduli, heat of hydration, shrinkage and creep.

The research performed at 2.1 will allow to postulate a full model describing all relevant processes connected to the hydration, strength development and durability of a Roman cement (Deliverable D 11).

**Task 2.2: Improving application techniques of mortars**

Additional research activities will be conducted on Roman cement mortars in order to evaluate and assess the best practice in application techniques, considering conditions frequently encountered in the restoration of buildings. This will include various aspects of the compatibility of Roman cement mortars with historic materials. Some of the tests listed below will be performed not only in the laboratory but...
also on site.

The following parameters will be researched:

- The impact of suitable retarders on the mortar properties, namely on the strength.
- The effect of the water/cement ratio and cement fineness on the hydration process and on the mortar properties, namely strength, porosity and shrinkage.
- The impact of various sands and the sand : binder ratio on mortar properties; important for a wide market penetration.
- The water retention capacity especially of thin mortar layers, important for the question of curing Roman cement mortar slurries on façades.
- The development of the pore-size distribution related to hydration and to carbonation upon curing at variable humidities and temperatures, using mercury porosimetry.
- The effect of water-repellent treatments on the processes of hydration in the fresh mortars, determining the necessary allowance for curing before a water repellent treatment may be applied, following the usual pressure to reduce time on site during the restoration.
- The impact of the properties of the substrate on which the mortar is cast (usually brick) and the thickness of the mortar layer; namely the effect of reduced effective water/cement ratios by the suction of water into the brick. The key parameters to assess are essential for the questions of compatibility: the compressive and tensile strength of the mortars and its elastic modulus, the tensile bond strength between brick and mortar, the way autogeneous and drying shrinkage of the mortar will affect the adhesion, the water transport across the joints in brick-mortar-brick sandwiches. The tests will also include on-site trials on historic and modern brick walls as well as laboratory wall so that an assessment of the adhesion strength can be made at various ages.
- Other specific questions to study will be defined by the end-users during a workshop.

All relevant data will be included in a Manual to be published as one of the key tools of WP 3.

The outcomes of the above tests will form the key issues of the manual on specifications for substrate and mortar conditions (see also Manual in WP 3, here Deliverable D 12).

**Deliverables:**

<table>
<thead>
<tr>
<th>D 11</th>
<th>Model describing all relevant processes involved in the hydration of a Roman cement paste</th>
</tr>
</thead>
<tbody>
<tr>
<td>D 12</td>
<td>Comprehensive set of data on the properties of Roman cement mortars as a function of external parameters governing the development of strength</td>
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**Objectives:**
Promoting Roman cement as a material and as a technological concept to the sector of conservation and construction

**Description of work:**

**Task 3.1: End-user Advisory Panel (EAP)**

Central in the project will be the role of end users. Approx. 20 representatives of conservation authorities at various levels – national, regional or municipal – from the participating countries as well as from Scandinavian countries, Hungary, Romania, Italy, and Spain will be directly involved in the project. They will help to identify problems and research priorities, and develop the optimum solutions from the perspective of the conservation practice. The EAP – steered by the co-ordinator in WP 4 - will be organised to assist the project in specifying end-user needs and review in detail the project activities. The advisory panel will meet for a two day workshop at the start of the project to identify barriers preventing the use of the Roman cement technology, to discuss the methodology of the project involving a range of measures aiming at the optimisation of handling cements and mortars, to give opinions, expectations and recommendations of the end-users which will be used in planning the laboratory work and field tests within the project, and to facilitate local conservation projects to be carried out by conservation partners from the SME sectors.

The EAP will meet also at mid-term of the project and provide input into the mid-term review (Deliverable D9) as well as a final review (Deliverable D16) on the progress particularly in respect to market-related issues. Delegates of the EAP will be also invited to attend the final workshops and encouraged to disseminate the project findings and results within their respective professional communities.

**Task 3.2: Creation of CI and construction of a project webpage**

Based on the design of a corporate identity, a project public and internal web-site will be created and regularly updated to inform about the project and promote its idea and the outcomes. It will also include the most important aspects of ROCEM and thus grant open access to both the ROCEM- and ROCARE-projects (Deliverable D5).

**Task 3.3: Brochure with manual on best practice in the application of Roman cements**

A brochure which will follow the general idea of presentation of the former ROCEM-brochures will be the frame to publish the Manual on best practice in the application of Roman cements. Yielding guidance to the use of the Roman cement technology in the various fields of application, the Manual will be a key publication to approach the market. Basically it will present and illustrate all relevant data researched in WP 2.2. in a multilingual way. The Manual will also be made accessible at the project webpage (Deliverable D14).
### Task 3.4: Workshops
National workshops will be organised as a 2-days events including hands-on facilities within the last year of the project duration, in order to promote the Roman cement technology.

### Task 3.5: Demonstration sites
Historic buildings selected with the help or by approval of EAP will receive a façade restoration using the Roman cement technology (Deliverable D15). Preference will be given to objects in need of a broad range of application techniques and with a full characterisation so that the results can be correctly described. The task will also include assessment of the historic materials and their decay, in order to design the mortars and their application techniques for the specific conditions.

### Task 3.6: Publication of the results in scientific journals and presentation at congresses
The outcome of the project will be published in peer reviewed journals as well as at congresses.

### Task 3.7: International conference
The outcomes of the project shall be presented to an international forum of experts and discussed in the broad context of lime and hydraulic binders; the event will last 3 days and include panel discussions on the various aspects of applicability of the Roman cement technology in conservation as well as in modern construction. The conference will be self-financing.

---

**Deliverables:**

- D 5 The ROCARE project website
- D14 Printed and web-based Manual on best practice in the application of Roman cements
- D15 Historic buildings restored by use of the Roman cement technology for demonstration purposes


<table>
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**Objectives:**

- Create the conditions necessary for the successful cooperation between the partners
- Ensure efficient communication between partners and the EU
- Steer the End-user Advisory Panel (EAP) and the major non-technical subcontractors

**Description of work:**

The principal management activities will be to monitor progress, maintain financial control, communicate with the EU, and steer the EAP as well as the basic strategies related to business and marketing. As for all other project activities, this will be based on the spirit of effective team work.

The main methods of communication will be e-mail and meetings. The latter will be organised at approximately 9-monthly intervals to ensure progress is being maintained, data and emerging issues commonly understood, and key Milestones achieved.

Agreement will be achieved on the test techniques so that data is compatible across the consortium, regardless of which Partner conducted the evaluation.

**Task 4.1:**

A professional customised Market Introduction Plan will be created by a subcontractor to the co-ordinator at the initial stage of the project, i.e. within the first 3 months. Its author has long-term experience in product marketing and application especially in the area of building renovation. The plan will help identify the potential markets and develop the best strategy to approach them (Deliverable D3).

**Task 4.2:**

A Consortium Agreement to be signed by all participants will be set up in due time before the start of the project. In accordance with the rules of the Commission, it will regulate relevant issues of cooperation and the exchange resp. protection of intellectual property within the consortium and towards the public (Deliverable D1). A Project Board will be established at the outset of the project, comprising the lead investigator in each Partner organisation, and at its first meeting will agree on:

- Practices for the resolution of disputes
- Roles and responsibilities of the project co-ordinator, workpackage leaders and other participants based on obligations contained in the contract
- Guidelines for external presentations and publications to develop a project corporate identity to complement an individual Institutional identity
- Release of information into the public domain and IPR of Partners
Draft of a Consortium Agreement

The minutes of the Project Board and Steering Committee meetings will form Deliverable D 2.

Task 4.3:
An End-user Advisory Panel (EAP) will be appointed (for more details see WP 3). The mid-term review of project results (Deliverable 9) and the final report of EAP (Deliverables D16) will be of high importance to evaluate the whole of the project and to define the future strategies of marketing.

Task 4.4:
Progress Reports on the scientific activities every 9 months, full mid-term report after 18 months and the final report after 36 months for submission to the EU (Deliverable D 8)

Deliverables:
D 1 Consortium Agreement
D 2 Minutes of all Project Board and Steering Committee meetings
D 3 Market Introduction Plan for Roman cements in Europe
D 9 Mid-term review of project results and their implementation according to the Mid-Term Assessment Clause
D16 Final review of project results and their implementation
D 8 Progress Reports on the scientific activities every 9 months, full mid-term report after 18 months and the final report after 36 months to the Commission

B1.3.6 Efforts for the full duration of the project

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Tentative schedule of project reviews

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B2. Implementation

B2.1 Management structure and procedures

Project management system has been devised to address co-ordination of the work based on well structured teamwork and quality control to ensure that the implementation of the project in the given timeframe and budget.

The consortium consists of four different groups of partners:

- producers of Roman cements
- research laboratories
- end users – restoration companies and an SME specialised in the formulation and distribution of the restoration materials
- institutions regulating issues of application

The project management structure reflects the composition of the consortium and the tasks and interests of the partners. The diagram of the management structure is shown in the Figure below:
Project Board
All project partners delegate one representative to the Project Board. The Board will meet every nine months to verify the project progress, especially to ensure that deliverables and milestones are satisfied on target. The Scientific Officer from the European Commission will be invited to the board meetings. The Board will be also entitled to deciding about major changes in the project implementation:

- major modifications of the project workplan and shifts in the budget
- exclusion of partners or acceptance of new partners
- changes in the Consortium Agreement

Coordinator
Institute of Art and Technology/Conservation Sciences, University of Applied Art in Vienna will be the coordinating unit and has assigned the managing responsibility to Professor Johannes Weber. The project co-ordinator will work together with the Steering Committee to ensure good progress of work and maintenance of proper communication within and outside the consortium in the spirit of effective teamwork. Internally, the project co-ordinator will supervise the activities of the partners, will inform them of any requirements of the European Commission and distribute the budget according to the partners cost statements. Externally, he will prepare all necessary reports to the European Commission as determined in the Contract.

The Conservation Sciences Group of IATCS has vast experience in managing the international collaborative research projects in the field of the heritage science. These include
two EUREKA – EURO Care projects, two EU RAPHAEL projects and two projects within the 4th and 5th Framework Programmes.

The coordinator Professor Johannes Weber has participated in the implementation of the above projects. He was the lead research partner to the 5th FP ROCEM project ‘Roman Cement to Restore Built Heritage Effectively’, which has re-established the manufacture and use of Roman cements to be introduced by the proposed project into the cultural heritage market. He has an ample experience in managing the international collaborative efforts, and is thoroughly familiar with the issues related to historic Roman cements.

The infrastructure of IATCS as well as its well-trained administrative personnel will ensure a smooth and efficient way of project management. Where needed, the team will be assisted by the relevant departments of the University of Applied Arts.

Work Package Leaders

Each Workpackage has a clear task oriented organisation, described in the workplan. The workpackage tasks will be implemented by respective research teams headed by a Workpackage Leader, a partner responsible for its management in collaboration with the Coordinator and the Project Steering Committee. In particular, each Workpackage leader will monitor if deliverables and milestones are satisfied on target, will compile yearly reports on the Workpackage activities, will control expenditures and take care of proper communication between the partners. Teams implementing workpackages can organise their internal meetings though attempts will be undertaken to cluster them with the project Steering Committee meetings or the yearly project meetings.

All Workpackage leaders are eminent specialists in various fields of heritage research and conservation practice and have vast experience in managing the international collaborative research projects:

<table>
<thead>
<tr>
<th>Work Package</th>
<th>Workpackage Leader</th>
<th>Organisation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Manufacture of Roman cements - WP1</td>
<td>Wolfgang Schwarz</td>
<td>Composite Anode Systems GmbH, Vienna, Austria</td>
</tr>
<tr>
<td>Optimisation of processing and</td>
<td>David Hughes</td>
<td>School of Engineering, Design and Technology, University of Bradford, UK</td>
</tr>
<tr>
<td>application technologies of</td>
<td></td>
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<tr>
<td>Roman cement mortars - WP2</td>
<td></td>
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<tr>
<td>Dissemination and marketing – WP3</td>
<td>Roman Kozlowski</td>
<td>Institute of Catalysis and Surface Chemistry, Krakow, Poland</td>
</tr>
<tr>
<td>Management – WP4</td>
<td>Johannes Weber – the</td>
<td>Institute of Art and Technology /Conservation Sciences, University of Applied Arts Vienna</td>
</tr>
<tr>
<td></td>
<td>coordinator</td>
<td></td>
</tr>
</tbody>
</table>

Steering Committee

The Steering Committee will comprise the coordinating institution and the workpackage leaders. The Steering Committee will be responsible for day-to-day overall administrative,
technical and financial management of the project. Two principal mechanisms for planning and management will be used i.e. meetings and e-mail. Meetings of the Steering Committee will be focused on key Milestones rather than organised at routine intervals. If necessary they will be combined with task-oriented meetings of the team implementing a specific workpackage. A standard agenda item for all Steering Committee meetings will be a review of activities by consortium members and a forward looking plan for the up-coming period.

**Advisory Panel of Regulating Institutions**

The Advisory Panel will comprise representatives of the conservation authorities at various levels – national, regional or municipal – which will provide the perspective of the institutions regulating the conservation works and will facilitate local conservation projects to be carried out by the end-user group. It will be chaired by the project Coordinator. The Advisory Panel will meet for a two day workshop at the start of the project to discuss the existing approaches and technologies for conservation of the built heritage of the nineteenth and early twentieth centuries, to identify barriers preventing the use of the authentic historic Roman cement technology compatible with the original stuccoes, to give opinions, expectations and recommendations of the end-users which will be used then in planning the laboratory work and field tests within the project. The conservation partners from the SME sector will collaborate with the respective local members of the Advisory Panel to facilitate and optimise the local conservation projects to be carried out within the project.

The Advisory Panel will be kept informed by the Coordinator about the developments in the project. The advisory panel of end-users will meet also at mid-term to participate in the mid-term review of the project and during the final workshop and will contribute to the dissemination of the project findings and results within the respective professional communities.

**Consortium Agreement**

A consortium agreement will be established at the outset of the project. It will specify roles and responsibilities of all partners, in particular concerning the organisation of the work, the management of the project, practices for resolution of disputes, release of information into public domain and IPR of partners, supplementing but not conflicting with those contained in the EC Grant Agreement and the EC Rules of Participation. In particular, preparation and organisation of meetings, sending and agreeing the agenda, voting rules and quorum, veto rights, and preparation of minutes will be described. Financial provisions based on the Consortium Budget and the Consortium Plan will be established. The Consortium Agreement will specify in detail the Intellectual Property Rights provisions concerning the protection and use of foreground resulting from the project, rules for dissemination of the foreground including scientific publications, access rights and other issues, supplementing the standard IPR contained in the Grant Agreement.

**Mid-Term Assessment Clause**

A Mid-Term Assessment Report on the progress of the research and the partners' plans for a future exploitation strategy will be submitted to the EC after 18 months from the date of commencement of the project.
The project co-ordinator will organise a Mid-Term Assessment meeting by the end of the 19th month with all partners, Advisory Panel Members and the Commission's representative, possibly assisted by independent reviewer(s) appointed by the EC. The purpose of this meeting will be to report on the progress to date and to redefine (if necessary) the work plan for the remaining part of the contract. Procedures for managing future exploitation of results will be discussed and assessed. A decision whether or not to continue the contract - or specific recommendations for the continuation of the contract - will be taken before the end of the 21st month having regard to the achievement of the specified objectives at this stage for S/T progress and co-operation and having regard to the exploitation perspectives for the results.

The following targeted achievements by the mid-term assessment will be listed and quantified in the mid-term report and discussed at that meeting:

- extended Market Introduction Plan for Roman cements in Europe is prepared in its final version, consulted and optimised by the End-user Advisory Panel
- appropriate raw materials available to the cement producing partners are selected for the production process and the optimal calcination conditions suitable for them are determined

    accomplishing this step is crucial for the next research and industrial steps of the project; it has been therefore identified as Milestone 1 in project’s plan – ‘Suitable raw materials for Roman cement production’
- sufficient amount of high-quality cements are produced in the pilot calcination processes so that laboratory testing programme is started
- further steps in processing of cements like grinding, sieving, mixing materials calcined at distinctly different firing conditions are optimised so that a full process cycle of the optimum Roman cements is described

The mid-term assessment is to be made against the satisfactory completion of the following programme items before month 18th: (in accordance with the list of deliverables and deadlines mentioned by 18 months):

D1  Consortium Agreement  
D2  Minutes of all Project Board and Steering Committee meetings  
D3  Market Introduction Plan for Roman cements in Europe  
D4  Data on appropriate raw materials and their optimum calcination temperatures  
D5  ROCARE project website  
D6  Roman cements produced through optimum pilot calcination processes, sufficient quantities for lab testing  
D7  Set of parameters describing optimum process cycles for Roman cement production  
D8  Progress reports on the scientific activities to the Commission every 9 months, full mid-term report to the Commission after 18 months and the final report after 36 months  
D9  Mid-term review of project results and their implementation according to the Mid-Term Assessment Clause
B2.2 Beneficiaries

Remark:

Beneficiaries No. 7 and 13 are missing for the following reasons:

- In an early stage of the negotiations, former partner No. 7 (FKD) has withdrawn his participation in the project which was approved by the whole consortium.
- The former partner No. 13 (MBM) had, for a technical reason, been cancelled by the nef-system. Upon re-insertion, this partner received number 16.

Participant 1 and the coordinator

IATCS - Division of Conservation Sciences at the Institute of Art and Technology, University of Applied Arts Vienna (Austria)

Together with two more divisions, IATCS emerged from the scientific unit of the former Institute of Conservation and Restoration-Technology which had been active in the field of scientific research on cultural heritage since the early 1980s. IATCS has a strong focus on mineral materials in historic sculpture and architecture. One of the main methodological emphases of the expertise lies in the use of microscopic and electron-optical methods in identifying and characterising historic materials as well as features of their deterioration and effects of conservation treatments. In this field, IATCS enjoys a national and international reputation reflected by publications and courses for students of conservation and restoration.

The IATCS has the following adequate equipment to carry out all its research tasks within the proposed project: a stereo microscope with reflected and transmitted light facilities and polarisers, a polarising microscope with reflected and transmitted light facilities, a scanning electron microscope (SEM) with secondary electron (SE) and backscattered electron (BSE) detectors, with alternative function as environmental electron microscope (ESEM) to work at low vacuum conditions, an energy-dispersive X-ray analysis system (EDX) connected to the SEM.

Short profile of the coordinator and the principal investigator of IATCS in the project

Prof. Dr. Johannes Weber, Head of IATCS, has a broad experience in the proposed topics, based on 25 years of research and academic training in archaeometric and conservation scientific issues of stone, mortars, mural paintings and related materials of architecture as well as of soluble salts. Prof. Weber received his doctoral degree in petrology/geology in 1983 and has since then continuously worked at the University of Applied Arts Vienna. Following achievement of the grade of a habilitated lecturer at the Faculty of Sciences at the University of Vienna in 2002, he received his professorship at the University of Applied Arts where he
continued his main activity in teaching of material sciences and related research. Additionally, he has been in charge of educational tasks both at the Academy of Fine Arts and the University of Vienna. Prof. Weber participated in several international research projects:

- Research project of the Central-European University „The Rescue of Baroque Rock Art by M. Braun at Kuks, CZ“
- EUREKA EU 496 EUROCARE-EUROMARBLE & EU 1382 EUROCARE-EUROPLASTER
- EU-Raphael 97/F/2 „Rendered Facades around 1900 in Europe“
- EU-Raphael-Project “Conservative Maintenance of the Sgraffiti”
- EU-5th FP Project EVK4-CT-2002-00084 ROCEM: “Roman Cement to Restore Built Heritage Effectively”

**Role in the project**

The institute will coordinate the project. Its main research work will be determining phase composition and microstructural feature of the clinkers produced within WP1 and mortars produced within WP2 using optical and scanning electron microscopy. These will be related to the known characteristics of historic cements and mortars. It will coordinate the activities of the Advisory Panel of the regulating institutions and work closely with other Austrian partners at the coordinated implementation of all research and dissemination activities.

Publications particularly relevant to ROCARE include (see also Partner 3):


**Participant 2**

**ICSC - Institute of Catalysis and Surface Chemistry, Polish Academy of Sciences (Poland)**

The Institute is a medium–size public research unit active in the field of physical chemistry of interfacial phenomena and catalysis. Since 1986 one of the research areas has been the investigation of the structure and properties of historic materials, mechanisms of their deterioration, and measures to conserve and protect them. Special emphasis is laid on phenomena occurring at the material surfaces, especially response of historic materials to changes in air parameters in their microenvironment using numerical modelling of climate-induced stress, acoustic emission, laser vibrometry, thermovision. The basic research has been
linked to extensive case studies. ICSC is equipped with state-of-the-art laboratory facilities to carry out the tasks assigned to it within the project including a mercury porosimeter, two vacuum microbalances for measuring adsorption of nitrogen and water vapour, powder X-ray diffractometer and the DTA-TG thermal analyser.

Short profile of the principal investigator of ICSC in the project

Dr. Roman Kozlowski graduated in chemistry at the Jagiellonian University in Krakow, Poland, in 1970. He received his Ph.D. in 1974 and D.Sc. in 1989 from the same University. In 1974 he joined the staff of the Institute of Catalysis and Surface Chemistry (ICSC), Polish Academy of Sciences, in Krakow. He became Research Fellow at the University of Warwick, U.K., between 1980 – 1983 and since 1986, head of research related to conservation science and protection of cultural heritage at ICSC. Since 1989, associate professor. His research focuses on microclimatic monitoring, elucidating porosity structures of historic materials, and their interaction with moisture. Member of the Working Group 4 ‘Environment’, Technical Committee 346 ‘Conservation of Cultural Heritage’, European Committee for Standardization. He has broad experience as the principal investigator or co-ordinator in several international R&D projects; the most relevant for the proposed project are listed below:

- The EC project ROCEM ‘Roman cement to restore built heritage effectively’, 2003-2005, Contract No EVK4-CT-2002-00084 (Co-ordinator)
- NOAH’S ARK - Global climate change impact on built heritage and cultural landscapes, EC 6FP project, 2004-2007

Publications particularly relevant to ROCARE include


Role in the Project

ICSC will be responsible for characterising pore structure of the Roman cement pastes and mortars prepared within WP2 using mercury intrusion porosimetry as a principal technique and determination of the specific surface area as an auxiliary method. Further, ICSC will
coordinate all research and field activities aimed at elucidating the compatibility between the various repair materials developed (renders and various thin finish layers) and the historic substrate. It will support the Co-ordinator in the organisation and operation of the End-user Advisory Panel. It will work closely with other Polish partners at the coordinated implementation of the local dissemination activities. ICSC will co-ordinate WP3 - Dissemination and marketing.

**Participant 3**

**UoB – School of Engineering, Design and Technology, University of Bradford (United Kingdom)**

The School comprises the disciplines of automotive, civil, electrical, mechanical and medical engineering, automotive and product design, and technology management. The School was formed in 2002 from previously independent discipline-based Departments and now operates as a fully integrated multi-disciplinary unit. Professor David Hughes was the School’s first Associate Dean (Learning and Teaching) responsible for some 40 degree courses, the teaching of 50 members of academic staff and allocation of finances to course teams. The School’s research emphasises the inter-disciplinary nature of modern society and is organised through 4 collaborative Research Groups. Prof Hughes is a member of the Environment and Infrastructure Group.

**Short profile of the principal investigator of UoB in the project**

Prof Hughes graduated in 1975 with a first class honours degree in civil engineering. He has worked in various research and teaching positions in 4 UK Universities and was awarded a PhD in 1983 for a study of fibrillated polyalkene films in thin-sheet cement products which were intended as a replacement for asbestos cement. Prof Hughes was a member of the ROCEM consortium and undertook the laboratory calcination of marls from 7 sites throughout Europe and the evaluation of the cements produced. He was a member of the project’s Steering Committee. Currently he is supervising two externally funded (Engineering and Physical Sciences Research Council and Knowledge Transfer Partnership) projects which are developing low-energy high-performance mortars for both the conservation and new-build markets; the developments are currently the subject of a patent application. His expertise includes characterisation of marls; composition of hydraulic limes, and natural and Portland cements; physical properties of pastes and mortars made from these binders; the interaction between mortars and porous substrates and the subsequent properties of the mortars; and the influence of curing conditions on mortars. The UoB laboratory is well equipped to undertake the mortar assessments required in the ROCARE project.
Publications particularly relevant to ROCARE include


Role in the Project

The principal role of UoB within ROCARE is to (i) provide guidance to the cement producers on the calcination of feedstock from their local sources, WP1; (ii) undertake the design, production and evaluation of mortars in relation to their architectural application, WP2, (iii) support the Co-ordinator in the organisation and operation of the End-user Advisory Panel, WP3 and (iv) contribute guidance on the formulation of Roman cement mortars.

UoB will co-ordinate the activities of WP2 - Optimisation of processing and application technologies of Roman cement mortars.

Participant 4

CAS - Composite Anode Systems GmbH, Vienna (Austria)

CAS Composite Anode Systems GmbH (CAS) is an innovative small enterprise founded by Dr Schwarz in July 1999 and operative since 2001. The main business activities of CAS are R&D, implementation of novel & innovative concepts, technologies and materials for the repair, rehabilitation and maintenance of concrete structures exposed to environmental stresses. Engineering and consulting support is an essential part of the activities of CAS. CAS readily cooperates with research facilities, innovative companies as well as customers such as public building administrations. CAS has an in depth experience in the chemistry of hydraulic binding materials. The R & D is based largely on the evaluation of QXRD, in-situ XRD,
ESEM, standard characterization techniques of renders and coating materials. CAS has an extended experience in electrochemical characterization techniques such as solid state pH measurements and solid state resistance measurements in mortars.

**Short profile of the principal investigator of CAS in the project**

W. Schwarz, director of CAS, received his doctoral degree 1979 at the Department of Technical Chemistry at the Swiss Federal Institute of Technology. He received his first training in the coordination in R&D, both industrial and industrial related, at the IBM research facilities at San Jose, CA. during his engagement as visiting scientist from 1980 to 1982. Scientific R&D at the University level followed from 1982 to 1986 in the field of solid state chemistry & electrochemistry, as well as with consulting projects for industry. He managed environmental related projects developing and implementing novel technologies for SGP (now VA Tech) in Vienna, Austria in cooperation with several universities and several subcontracting companies. He managed a task force for HOLCIM Ltd, Switzerland for the development of a novel product line of highly durable and rapid hardening cements. He played a leading role in co-ordinating the hydration studies in the ROCEM project.

Publications particularly relevant to ROCARE include


Role in the Project

CAS will co-ordinate the work of the cement producers in WP1 to ensure that optimum cements are produced. It will also co-ordinate the hydration studies executed by Partners 1, 2, 4 and 5 to ensure that maximum account is taken of the interpretations developed within the ROCEM project, WP2. CAS will further perform the studies on carbonation in mortars related to water transport with solid state pH and resistance probes.

Participant 5

EPFL - Laboratory of Construction Materials, Lausanne (Switzerland)

The EPFL, one of the Swiss Federal Institutes of Technology is a leading European research university – the Laboratory of Construction Materials (LMC) consists of about 30 researchers studying various aspects of cementitious materials from hydration mechanisms to the links between microstructure and mechanical properties and durability. It is the world leading laboratory on quantitative methods for the characterisation of cementitious microstructures, including a dedicated SEM and XRD for cementitious materials. It has extensive experience in studying and understanding the mechanisms of hydration.

The Group is also at the centre of the Nanocem network – a European Industrial / Academic Partnership for fundamental research on cementitious materials founded by Professor Scrivener. Nanocem has funding for a Marie Curie Research training Network under FP6, which involves 9 ESR and 6 ER.

Short profile of the principal investigator of EPFL in the project

Professor Karen SCRIVENER received her BA in Natural Sciences from Cambridge, an MA in Material Science from the University of Pennsylvania and a PhD from Imperial College. She worked as a Senior Scientist with Lafarge in Lyons before being appointed to ERPFL in 2001. She is a leading expert in microstructural investigations of cement and concrete using scanning electron microscopy, image analysis and x-ray diffraction. She has extensive experience in both academic and industrial research and is the founder and co-ordinator of “Nanocem” for which she was awarded the Dykerhoff prize in 2007, this is the first time the award has been made in the field of material science. She is a Fellow of RILEM (International Union of laboratories and experts in construction materials systems and structures) where she co-ordinated technical committees on durability. She is Editor in Chief of Cement and Concrete Research which is the leading international academic journal in its field and has 94 publications.
**Equipment / Resources**

SEM, XRD dedicated for research on cement and concrete
Polishing equipment for SEM specimen preparation
Access to Transmission Electron Microscopy at EPFL
Thermogravimetric Analysis, Mercury Intrusion Porosimetry, Nuclear Magnetic Resonance, Concrete laboratory, with facilities for mixing up to 1m$^3$
Full range of mechanical testing equipment

Publications particularly relevant to ROCARE include


**Role in the project**

The principal role of EPFL within ROCARE is to conduct a fundamental study of the hydration of Roman cement, using SEM, in-situ XRD, DTA-TG, phase analysis by light microscopy, and standard mortar test procedures. This work will enhance and extend the current understanding of the performance of Roman cements established by Partners 1, 2, 3 and 4 within the previous ROCEM project. It will establish correlations and explanations of the observed performance of both laboratory mortars and those applied in practice.

**Participant 6**

CPP-LRMH - Cercle des Partenaires du Patrimoine - Laboratoire de Recherche des Monuments Historiques, Champs-sur-Marne (France)

The Historical Monuments Research Laboratory (LRMH) is a national public service linked to the Architecture and Heritage department (Ministry of Culture and Communication). The LRMH activities are devoted to studies and research on conservation of buildings, artefacts and objects which are listed as “Historical Monuments”. It works in partnership with architects, curators and conservators within the frame of the preliminary studies, restoration work or scientific surveys. It is composed of 38 permanent staff members (geologists,
chemists, microbiologists, materials engineers...). Its research fields are the main materials of
the cultural heritage (stone, stained glass, mural paintings, rock paintings, polychromes on
wood and stone, metal, concrete, textiles, wood), the causes and mechanisms of degradation,
the treatments applied to deteriorated monuments and artworks, and the environmental indoor
and outdoor conservation conditions.

The scientific equipment of the laboratory allows numerous analyses:
- observation of artefacts and degradation by optical microscope and scanning electron
  microscope;
- chemical analysis by X-ray fluorescence spectrometry, infra-red spectrometry,
  chromatography (HPLC, GCMS, and Ion chromatography), SEM-EDS, X-ray diffraction,
  Laser-induced breakdown spectroscopy;
- mechanical, optical and petrophysical measurements (dynamometer, colorimetry, Hg
  intrusion porosimetry, capillarity measurements);
- artificial weathering of materials and chemicals for restoration;
- microbiological analyses;
- in situ diagnosis methods: environmental measurements (temperature, RH...), ultrasonic
  measurements, rebars location, potential and Rp measurements;
- data acquisition and remote processing for environmental data.

Several studies devoted to the impact of the environment on materials are performed by the
Cercle des Partenaires du Patrimoine, which is a non profit making organization linked to the
LRMH, and located in the same premises. During the 5 past years they have gradually developed an
expertise in the field of natural cements as within the frame of the CPP, 2 national projects were dedicated
to the study of monuments made of concrete from the middle to the end of 19th century in the French
Rhône-Alpes region, cradle of the French cement industry.

**Short profile of the principal investigator of CPP-LRMH in the project**

Mrs Isabelle Pallot-Frossard is an Art historian, head curator of cultural heritage,
specialist of stained glass windows, Head of the Laboratory for 15 years;

Mrs Elisabeth Marie-Victoire is a materials engineer, in charge of the concrete
department, already participating in European networks as CONREPNET;

Dr Véronique Vergès-Belmin is a geologist responsible of the stone department, chair of
the international committee of Icomos for stone, participating in the ongoing EU project
DESALINATION.

Publications particularly relevant to ROCARE include

1. V. Vergès-Belmin, C.Gosselin, Un matériau novateur utilisé à la cathédrale de Bourges au XIXe
2. E. Cailleux, Les ciments naturels moulés en Rhône-Alpes et leurs altérations, Monumental,
3. E. Cailleux, E. Marie-Victoire, D. Sommain, Study of natural cements from the french Rhône-
   Alpes region, Heritage, Weathering and conservation, Proceedings of the international conference
Role in the project

The principal role of CPP-LRMH within ROCARE will be within the characterisation of historic Roman cement mortars and related building materials within field tests and demonstration works of the Tasks 2.2 and 3.5. This will be achieved through petrographic and mineralogical analysis along with measurements of e.g. adhesion properties to the substrate.

Further on, CPP-LRMH will organise and co-ordinate the French representative(s) to the EAP- advisory panel and assist in spreading information about the project to the community in charge of cultural heritage.

Participant 8

UPFR - University Pardubice, Faculty of Art Restoration, Litomyšl (Czech Republic)

The Faculty of Art Restoration in Litomyšl as a part of the University Pardubice and one of the six Faculties was established in 2005 in continuation of the Institute of Restoration and Conservation Techniques which had been formed in Litomyšl in 1993.

The structure of the Faculty is as follows:
- Studio of Restoration of Wall Painting and Sgraffito
- Studio of Restoration of Stone and Related Materials
- Studio of Restoration of Paper, Bookbinding and Documents
- Studio of Restoration and Conservation of Artworks on Paper and Related Materials
- Department of Chemistry and Technology of Restoration
- Department of Humanities

The course scheme at UPFR is aimed at training in the above areas using up-to-date knowledge and methods as well as specific theoretical knowledge. The programme provides its graduates with a thorough understanding of science and art history, a practical experience of materials, techniques and technology of restoration in pertinent subjects with the awareness of the inter-disciplinary context. The preparation of complete restoration concepts, including documentation, diagnosis, art historical evaluation and the restoration itself is a focal point in teaching and research.

UPFR performed investigation and restoration of different monuments and historical facades and participated also in national and international research projects, such as in frame of a Raphael-project (Barcelona, 1997-98), a German-Czech bilateral project (Moravská Třebová, 1997-98), a conservation project of UNESCO / ICCROM (Probota, Romania, 1997-98), and to 5th FP EU-projects (NAMO – “Nabatean Mortars – Technology and Application”, 2003-05 and ROCEM – „Roman Cement to Restore Built Heritage Effectively“, 2003-06).
In course of the latter project activities, UPFR has achieved ample knowledge of historic Roman cements from scientific, technical and historic points of view.

**Short profile of the principal investigator of UPFR in the project**

MSc. Karol Bayer, Head of the Department of Chemical Technology at UPFR, has received his degree in Chemistry in Conservation and is a leading expert in conservation sciences, namely related to stone and materials of architecture. He has been fully involved in the ROCEM-project as the head of the Czech group of participants, focusing on issues of material-science and application-technology. His experiences associated to the planned activities are based on research, academic training, participation in national and international projects in the field of conservation and restoration focused on stone, mural paintings and architecture.

**Role in the Project**

The principal role of UPFR within ROCARE is to contribute to laboratory and on-site test applications of Roman cement mortars within WP2; to perform measurements of mortar properties related to water transport phenomena (absorptivity, vapour diffusion); to organise and perform on-site trials in WP2 and WP3; to organise the End-user Advisory Panel – EAP in CZ; to contribute to the Manual on best practice in the application of Roman cements; to organise workshops in CZ; in general, to organise all measures of dissemination of the Roman cement technology in CZ.

**Participant 9**

**RFPL – Remmers Fachplanung, Löningen (Germany)**

Being part of the Remmers Group, RFPL is responsible for organisation and working on following assignments within this group:
1. Establish concepts for restoration projects especially in the field of cultural heritage, on the basis of scientific and technical data of the objects.
2. Give practice-oriented input to the Remmers Baustofftechnik in respect of design and quality control of their product systems for cultural heritage conservation.

RFPL was founded in 1995 as a department of the Remmers Baustofftechnik. As such, it was called ZOA (Zentrale Objektabteilung / Central Object Department). In the beginning of 2006, the department was transformed into an independent company, integrated in the structure of the Remmers Group but operating autonomously.

Since the operational beginning, RFPL has worked on several hundreds of objects in the field of cultural heritage all over Europe (Germany, Poland, Austria, Norway, Croatia, Romania, Czech Republic). Some outstanding examples are St. Stephan’s Cathedral / Vienna,
Brandenburger Tor and Reichstag / Berlin, Concentration camp / Auschwitz, Cathedral of Freiburg (DE), Oscars Hall / Oslo. Especially in the case of the latter two objects, the handling of mortar products based on Roman cement were in the centre of attention by solving the defined assignment. RFPL was thus amongst the first to use Roman cements derived from the ROCEM-project for restoration purposes.

In the field of product design, RFPL has performed particular projects on the following topics:
1. Renders for moist walls and salt-loaded structures - national research project.
2. Conservation substances for natural stone, brick and historic plasters (silicic acid ester consolidant system, restoration mortar system) - national research project.
3. Redesigning of historic mortars based on different binders; in this area of activity falls the participation as a contractor to ROCEM, the first EU-project dealing with Roman cement as a historical binder.

RFPL has joined several committees of WTA (Wissenschaftlich Technischer Arbeitskreis), an international panel elaborating standards for practical work in the cultural heritage field. Among others, RFPL’s input to WTA is in the field of sacrificial renders, desalination, and painting systems for historical façades.

Numerous papers have been published by the staff of RFPL on the above topics.

**Short profile of the principal investigator of RFPL in the project**

Dr. Georg Hilbert, graduated geologist and general manager of RFPL, had been consultant to the ROCEM-project group. In the following, he achieved assumption of pre-mixed mortars based on ROCEM - Roman cements to the product range of Remmers. – Numerous publications.

**Role in the Project**

The principal role of RFPL within ROCARE is to advise on the appropriateness of Roman cement mortar recipes as to their applicability in practice, and define cement parameters and mortar recipes in view of the desired properties. RFPL will further optimise recipes and methods for site trial applications of Roman cement mortars in WP2 and WP3, in collaboration with partners 2, 3, 6, 7, 8, 10 and 15; they will also provide laboratory and ND-on-site measurement facilities for these trials. RFPL will contribute to the Manual on best practice in the application of Roman cements, and assist partner 7 in organising measures of dissemination of the Roman cement technology in Germany. They will finally make available their Europe-wide contacts to end-users for project dissemination purposes.
AGW is a private atelier, founded in 1978 by its owner Mag. art Christian Gurtner, and specialised in conservation and restoration of stone monuments and mosaics.

The firm is located in Vienna and mainly operating in the eastern part of Austria. In close cooperation with the Federal Office for The Care of Monuments (“Bundesdenkmalamt”) and with the University of Applied Arts in Vienna, AGW assumes tasks in conservation and restoration from governmental and clerical organisations as well as from those in the private sector. Closely related to these efforts is the assessment and prevention of damage of historical monuments which forms another crucial point of AGW’s work. In addition, the company is focussing on all aspects of elaborating concepts of intervention for architectural and sculptural objects, including façades from baroque times up to the early 20th cent.

In the past few years, AGW was, amongst others, performing and completing restoration and conservation of the Byzantine Mosaic in the Great Palace of Constantinople. Further references of importance are: Schoenbrunn Imperial Palace, Carnuntum (Roman museum), Heiligenkreuz Convent, Vienna Cathedral, Austrian Hofburgtheater, several castles in Lower Austria, a 1900 façade by Plecnik in Vienna (in frame of a EU-Raphael project), Otto Wagner Church Steinhof, etc.

AGW participated as a partner in the EU-5th FP project ROCEM - Roman Cements to Restore Built Heritage Effectively.

At present, there are 4 full-time employees and 5 more collaborators on a free-lance base. All of them are academically trained persons.

AGW is equipped according to the most modern standards.

Short profile of the principal investigator of AGW in the project

Mag. Art. Christian M. Gurtner has received his master degree in restoration and conservation by the University of Applied Arts Vienna following his formation in wood and stone sculpturing. He is University lecturer at the University of Applied Arts Vienna and has supervised a master thesis on the use of Roman cement mortars for architectural heritage conservation. In course of the ROCEM-project, Mag. Gurtner has substantially contributed to study, application and promotion of the Roman cement technology in Austria and in surrounding countries.

Role in the Project

The principal role of AGW within ROCARE is to conduct application trials of the Roman cements produced by the project, both in laboratory and on trial sites (WP 2); further, AGW will perform on-site restoration works based on the Roman cement technology for
demonstration purposes (WP 3), advise producers to meet the key demands of end-user application, organise the End-user Advisory Panel - EAP in Austria, and co-organise national workshops in Austria.

**Participant 11**

**TPA - Gesellschaft für Qualitätssicherung und Innovation GmbH (Company for Quality Auditing and Innovative Solutions, Ltd), Vienna, (Austria)**

TPA is a centre of competence for quality assurance/consulting and R&D in the field of construction. They are running a certified laboratory providing quality assurance, failure diagnosis and consulting services to road and building construction.


TPA has a laboratory accreditation for EN 45001 and is equipped with a wide range of laboratory facilities to test soil, concrete and stone materials with different methods according to ASTM, DIN, EN, OeNORM, providing all kinds of mechanical strength tests, dilation measurements, durability test devices including a large climatic room for frost-thaw cycles, as well as various analytical instruments such as RFA and XRD. TPA is also performing service in exploration of gravel and ground water by geoelectrical sounding.

**Short profile of the principal investigator of TPA in the project**

Mag. Walter Strasser, operational manager at TPA, has received an engineering degree in silicate technology and later on a university master degree in petrology. He is member of various professional panels such as the Austrian committee for standardisation (member of the groups of Soil mechanics, Natural stone, and Road- and Airfield construction), and the Austrian research company for road traffic and road (working group: Stone material), University lecturer at Vienna University and at the German-Austrian-Swiss Association for Natural Stone. Mag. Strasser holds a license as consulting engineer for geotechnical engineering. His project experience within TPA include assessment of landfill sites and gravel and quarry areas in Austria, Russia, Germany, Czech Rep., Hungary, Slovakia, Poland, Ukraine, Serbia, Norway, Bulgaria, Romania, Turkey, Oman, VAE, Qatar, Bahrain, Kenia, Uganda, and Rwanda.

**Role in the Project**

The principal role of TPA within ROCARE is to provide various laboratory facilities to control quality of Roman cements produced by partner 14, to perform tests of mortar properties within the activities of WP 2, particularly related to freeze-thaw durability, and to contribute to the Manual on best practice in the application of Roman cements. Further on, through their multiple contacts to construction firms in Europe and through the activity of
their managers in various technical panels, TPA will be an important strategic partner to disseminate Roman cements on the market and to find additional fields of application.

**Participant 12**

**WP - Wietersdorfer & Peggauer Zementwerke GmbH, Klein St. Paul, Austria**

Wietersdorfer & Peggauer Zementwerke GmbH (w&p) is part of the „Wietersdorfer Gruppe“ and producer of cement, lime and other binding materials as well as premixed dry and wet mortars. Cement production in Wietersdorf has been started about 115 years ago, so there is a long tradition and experience in that field in the company. At present, W&P has got three production sites in Austria, namely Wietersdorf (cement, premixed dry and wet mortars), Peggau (cement, lime and premixed dry mortars) and Leoben (premixed dry mortars).

Within the company, different types of technology are used for the production of various binding materials. The Wietersdorf plant is equipped with a dry kiln for clinker production, whereas a so called Lepol kiln is used for clinker production in Peggau. Lime production in Peggau is presently performed using a shaft kiln and an annular shaft kiln, another type of kiln is under construction. Besides, there are several mills for grinding the burnt material to suitable grain size when necessary. This shows that the participation of W&P offers a wide range of production facilities for the scale up of the production of Roman cement to an industrial level.

There are laboratory facilities in each of the production plants, which are used for both product development and control of production. The apparatus includes for example XRF, XRD and ICP. Besides we are equipped to do wet chemical tests. Physical tests include for example granulometry, penetration, flow, setting times, flexural strength, compressive strength and elastic modulus.

**Short profile of the principal investigator of WP in the project**

Dr. Eva Wolf will be responsible for the coordination of the W&P activities within the project. She studied chemistry at Graz University of Technology and received her doctoral degree in 1990. From 1985 she was doing research work at the Institute for Analytical Chemistry, Micro- and Radiochemistry of this university with a focus on XRF trace element determination from geologic material for geochemical purposes. 1992 she left university and changed to W&P, where she has been responsible for the cement laboratory in the Peggau plant at the beginning. At present she is responsible for quality management and R&D on lime products within the company. Thus she has got more than 15 years experience in cement and lime industry meanwhile. Being Austrian member of WG 11, a working group of CEN TC 51, she is contributing to standardisation of building lime.
Role in the Project

The principal role of W&P within ROCARE is to burn Roman cement from various raw materials using different kiln types, scaling up to and optimizing the production. The burnt material will be ground to adequate grain size for use. Quality and production control will be carried out during and after the production process and will include analysis of the material composition, granulometry, setting times, soundness and strengths for instance. The Roman cements prepared in this first step (WP1) will be used as binders in different mortars in a second step (WP2).

Participant 14

VFB - Verein zur Foerderung der Baudenkmalpflege (Association for the Advancement of the Architectural Heritage Conservation), Vienna-Mauerbach (AT)

VFB is registered in Austria as a private non-profit organisation, according to the Austrian Law of Associations. Founded in 1997 by the initiative of members of the Federal Office for the Care of Monuments, its statutes define the vicinity of VFB to that office. It can thus be defined as a group of experts linked to a public state institution involved in the regulation and control of materials and their application in architectural heritage restoration.

As to date, the members of VFB amount to 23 persons, predominantly university graduates such as architects, scientists or conservators who hold key positions in their field of profession. The association has no permanent staff but is granting paid service contracts whenever appropriate. It is running a small scientific laboratory but would rather hire access to apparatus.

The activities of VFB within the past years were manifold and comprised conducting funded research on topics such as the long-term weathering behaviour of building stones, render consolidation by the action of bacteria, outdoor-exposure tests of different types of mortar, etc. Further on, several expositions on topics of architectural heritage were co-organised by VFB, a large number of specialisation courses in conservation were held for architects and craftsmen, and limited quantities of lime were produced for specific needs in heritage conservation, following traditional techniques of production which have become extinct in most of Europe. In this way, much experience was gained with construction of kilns capable to calcine a few tons of aerial lime, hydraulic lime or Roman cement. The latter was manufactured in close collaboration with the former 5th FP ROCEM-project of the European Union.
Short profile of the principal investigators of VFB in the project

Prof. Dr. Andreas Rohatsch, current chairman of VFB, is professor of Technical Geology at the University of Technology Vienna.

Dr. Karl Stingl, free-lance conservation scientist, has a degree in geology and long-term experience in all steps of production and preparation of binders. He has been active in kiln construction, calcination and slaking resp. grinding of lime and natural cements within the past 10 years. As a contractor to the former ROCEM-project, he has advised the consortium in issues of raw materials, kiln types and cement processing.

Role in the Project

The principal role of VFB within ROCARE is to optimise a traditional technology of Roman cement production using a marl from the historic Roman cement source in Kufstein, Tyrol. The process will be based on a small self-constructed shaft kiln of the discontinuous type, with additional steps such as grinding and quality control of the cement performed by external premises. VFB stands for a high-level case-to-case supply of specific brands of Roman cements for special needs in the architectural heritage conservation. These cements will be investigated in WP2.

Participant 15

RENOVA – Renova Sp z o.o., Warsaw (Poland)

RENOVA Ltd - the atelier of conservation and restoration of historic monuments - was established in 1998 by its present owner Konrad Grabowski, and is a continuation of his activity as a freelance restorer since 1988. Presently RENOVA employs 20 staff members qualified in the conservation of works of art, sculpture, stuccowork, gilding and stonemasonry. The technical staff comprises also a construction site manager and an art historian responsible for the documentation. The company is well equipped to carry out conservation projects including scaffoldings and means of transportation. The company’s main focus is on comprehensive restoration projects, especially on historic facades with elaborate decorations in stucco, stone or ceramic bricks.

The accomplished restoration projects comprise: the facade of St. Anne church in Warsaw, historic buildings of the Warsaw University, interiors of the Royal Painting Academy, a part of the Royal Castle in Warsaw, the heritage industrial complexes of the waterworks in Warsaw and paper mill in Konstancin near Warsaw (for which the company received the award of the best national restoration of 2004), several country houses and their park pavilions in Poland. The company collaborated also on creating the Europa Park in Rust near Freiburg, Germany. Since 2006 the company has been engaged in the conservation of interiors of the Teutonic Castle in Malbork, Poland, World Heritage Site, and of the
Cistercian Monastic Complex in Goscikowo-Paradyz, also Poland. The company has a considerable experience in conserving and reconstructing stucco works, especially manufacturing of the architectural castings, also using Roman cements.

**Short profile of the principal investigators of RENOVA in the project**

Konrad Grabowski graduated in restoration and conservation from the Department of Fine Arts of the Nicolaus Copernicus University in Torun, Poland, in 1985. He has qualifications in stone and architectural conservation certified by the Museum of Culture and Art, State Service for the Monument Protection and Department of Architecture of the Warsaw Technical University. He is a member of several professional organisations. Since 1988 a freelance restorer with a considerable record of accomplished conservation works on stone sculptures, architectural details, stuccoworks and metal elements, preparatory studies elaborating conservation strategies and programmes, management of conservation teams. Since 1998, he is the owner and the principal conservation expert of RENOVA Sp z o.o.

**Role in the Project**

The principal role of RENOVA within ROCARE will be to carry out testing and application trials of the Roman cements produced by the project, both in the workshop and on-site (WP 2); further, RENOVA will perform on-site restoration works based on the Roman cement technology developed for the demonstration purposes (WP 3), provide the end-user perspective and expectations to the Roman cement producers and collaborate with other project partners on organising the national workshop in Poland.

**Participant 16**


Branch of Mineral Building Material, based in Krakow, Poland, is the research and development institution focused since 1954 on the prospecting and the rational exploiting of the natural resources, development and optimization of the production technology of the mineral building materials, development of the recycling technology of the industrial and municipal waste materials, research on raw minerals, waste materials and construction products properties.

MBM is certified body No 1487 within the framework of the EC Directive 89/106/EEC. The members of the research staff participate in the activities of several Technical Committees of
the European Committee for Standardization and the Polish Committee for Standardization concerning cement, lime, gypsum and related construction materials. Consequently, MBM is responsible for the certification of the conformity of the mineral construction products with the harmonised European standards to enable CE marking, Polish national standards and technical approval documents. MBM has well equipped laboratories and skilled scientific and technical staff. MBM provides ample scientific and technical consulting service on all relevant areas of its expertise.

MBM specializes in the production of cements for special purposes, dry mixtures and cement-based composite materials. It offers services of mechanical processing of raw material: cement clinker, lime, gypsum and lime stone. On special orders, MBM constructs prototypes of industrial equipment and measurement devices. In 2004 and 2005, MBM developed, in a close collaboration with the research team implementing the EC ROCEM project, a pilot-scale prototype production of Roman cement using its small rotary kiln. It has also developed procedures for the quality control of the Roman cements produced. The experimental production of the prototype Roman cement has been continued and the products have been successfully applied in a number of restoration works.

Short profile of the principal investigator of MBM in the project

Dr Grzegorz Adamski graduated in chemistry from the Jagiellonian University in Krakow, Poland in 1998, and received a PhD in 2004 from the same university. In the same year he joined the staff of the Institute of Catalysis and Surface Chemistry, Polish Academy of Sciences, Krakow, as a research fellow. Since 2007 he is engaged in research carried out at MBM related to Roman cements. His research focuses on solid state chemistry, corrosion and conservation of building materials. Principal techniques used are sorption of gases including water vapour to elucidate the pore structure of the historic materials, mercury intrusion porosimetry and thermal analysis methods.

He has participated in two research projects focusing on the re-establishment of Roman cements in the practical conservation:

- EU-5th FP Project EVK4-CT-2002-00084 ROCEM: “Roman Cement to Restore Built Heritage Effectively”
- National research project WKP_1/1.4.1/1/2005/8/8/222: “Implementation of the Roman cement technology in to the practical conservation”

Role in the Project

The principal role of MBM within ROCARE is to implement the serial production of the optimised, high-quality Roman cements in an experimental rotary kiln using single source marl from the active Folwark quarry in Poland which will be investigated in WP2.
B2.3  Consortium as a whole

The proposed ROCARE aims at the industrial development and the transfer into the market of Roman cements, key materials for high-quality restoration of the architectural heritage of the nineteenth and early twentieth centuries. The concept of the project is based on the collaborative action of the whole chain of partners possessing required expertise: from Roman cement producers, supported by scientific laboratories, to end users acting on the heritage market. Special attention is also paid to the input of the decision makers - conservation authorities at various levels which are also included in the project. Each Partner brings their own particular expertise to the consortium; however, there is an overlap in the background experiences of some Partners which will enhance the rigour with which the consortium will scrutinise the work of all Partners to the benefit of market penetration.

Producers of Roman cements

The producers group – companies strongly differing in their size, technical premises and commercial policies – will produce and optimise production of Roman cements, wherever needed advised and assisted by the scientific units group. This part of the project will enable transfer of the cement technology to a competitive level. This group will expand the range of both production technologies and the source of suitable feedstock. The following partners belong to this group: 12, 14 and 16. This group will especially benefit from the largely laboratory based calcinations of Partners 1, 2, 3 and 4 from the ROCEM Project. Especially partners 3, 4 and 11 will provide support to this group.

The scientific group

Public and private laboratories will use the cements to study their performance under standard laboratory conditions as well as in respect to “real-life” requirements, defined by the active participation of the end users and the regulators. This part of the project will deepen the understanding of the processes involved in the use of Roman cements and give clear technical advices on how to design, mix, process, apply and cure Roman cement mortars for the various fields of application. Analysis of historic materials and assessment of durability and compatibility of mortars will additional issues. The following partners belong to this group: 1, 2, 3, 4, 5, 6, 8 and 11.

The end user group

These are restoration companies and a conservation-oriented university institute. They will address the specific demands related to the practical use of the cements and test them by producing mortars and applying them in laboratory and on-site trials, thus creating demonstration objects used to promote the technology. The group comprises an SME specialised in the formulation, distribution and application of restoration products which will act as a multiplier of the technological concepts achieved. The following partners belong to this group: 6, 8, 9, 10 and 15. Especially partners 3 and 4 will provide additional support to this group.

The described structure is summarised in Table B2.1.
The regulating institutions

These are conservation authorities at various levels which will ensure good communication between the project team and the potential end-users to identify problems and research priorities, and thus help minimize barriers preventing the use and performance of the Roman cement technology. In addition, they will facilitate local conservation projects to be carried out by the end user-group. The following institutions belong to his group: Austrian Federal Office for the Care of Monuments, Bavarian State Office for the Care of Monuments, Czech National Institute for the Care of Monuments, English Heritage, Historic Scotland, French Ministry of Culture and Communication - Architecture and Heritage Department, City of Krakow - Municipal Office of Monument Restoration, City of Vienna - Cultural Heritage Department, and others to be appointed.

It is clear that the Project has been designed so that there is the maximum integration of each group and existing knowledge of Partners with the expertise of the consortium. Many of the Partners have a history of successful collaborations with each other in other projects and these established working relationships will minimise risks.
Table B2.1: Partnership and distribution of roles

<table>
<thead>
<tr>
<th>No.</th>
<th>type of organisation</th>
<th>key tasks in ROCARE</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Producers</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>private industry</td>
<td>cement production (shaft kiln, Lepol kiln); quality control</td>
</tr>
<tr>
<td>16</td>
<td>Non-profit public RTD</td>
<td>cement production (rotary kiln); quality control</td>
</tr>
<tr>
<td>14</td>
<td>Non-profit private RTD-institution</td>
<td>cement production (traditional shaft kiln)</td>
</tr>
</tbody>
</table>

| **Scientific units** | | |
| Institute of Art and Technology/Conservation Sciences, University of Applied Arts, Vienna, Austria | University | Project coordination; cement analysis; historic mortar analysis; dissemination |
| Institute of Catalysis and Surface Chemistry, Krakow, Poland | Non-profit public RTD | Paste characterisation; mortars: compatibility; dissemination |
| School of Engineering, Design and Technology, University of Bradford, UK | University | cement production (advising); mortars: design and test; dissemination |
| Composite Anode Systems GmbH, Vienna, Austria | SME | cement production (co-ordination); paste analysis – hydration (co-ordination); mortars: carbonation |
| Laboratory of Construction Materials, Swiss Federal Institute of Technology, Lausanne, Switzerland | University | paste analysis - hydration |
| Laboratoire de Recherche des Monuments Historiques, Champs sur Marne, France | Non-profit public RTD-institution | historic mortars: analysis; mortars: durability and compatibility; trial applications; dissemination |
| Gesellschaft f. Qualitaetssicherung und Innovation, Vienna, Austria | private SME / certified test laboratory | cements: quality control; mortars: compatibility; dissemination; marketing |

| **End-users (some with additional scientific tasks)** | | |
| University of Pardubice - Faculty of Art Restoration, Litomyšl, the Czech Republic | University | mortars: durability and compatibility; trial application (partly subcontracted); dissemination |
| Remmers Fachplanung, Loeningen, Deutschland | private industry RTD-laboratory | mortars: design for end-user purposes, durability and compatibility; dissemination; marketing |
| Atelier Gurtner, Vienna, Austria | SME | application; dissemination |
| RENOVA Ltd, Warsaw, Poland | SME | application; dissemination |
Subcontractors

Few works within ROCARE will be subcontracted, since they can not be adequately performed by the consortium. Subcontracts are specified in the table below.

<table>
<thead>
<tr>
<th>Partner to whom subcontractor is allocated</th>
<th>Work-package no.</th>
<th>Subcontracted work</th>
<th>Presumed subcontractor</th>
</tr>
</thead>
<tbody>
<tr>
<td>VFB</td>
<td>WP 1</td>
<td>Processing of Roman cements (grinding)</td>
<td>NN</td>
</tr>
<tr>
<td>IATCS</td>
<td>WP 2</td>
<td>Special issues of Roman cement compatibility and market introduction in Germany</td>
<td>Fachlabor fuer Konservierungsfragen in der Denkmalpflege, Munich</td>
</tr>
<tr>
<td>CAS</td>
<td></td>
<td>Lab studies on carbonation in mortars related to water transport</td>
<td>NN</td>
</tr>
<tr>
<td>IATCS</td>
<td>WP 3</td>
<td>Creation of ROCARE’s corporate identity and Project website layout</td>
<td>Atelier Klell, Vienna</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Production and maintenance of the ROCARE-website</td>
<td>NN</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Brochures for information and promotion, including the Manual on best practice in the application of Roman cements (1000 copies)</td>
<td>Atelier Klell (layout and typesetting)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Technical premises for façade restoration (scaffolding and similar)</td>
<td>NN</td>
</tr>
<tr>
<td>UPFR</td>
<td></td>
<td>Market and business plan</td>
<td>Peter Butz – Handelsvertretung für bauchemische Produkte und Bauphysik, Neuenrade (Germany)</td>
</tr>
<tr>
<td>ISCS</td>
<td></td>
<td>Management</td>
<td>NN</td>
</tr>
</tbody>
</table>

The selection of three subcontractors prior to the start of the project is justified as follows:

- Fachlabor für Konservierungsfragen in der Denkmalpflege in Munich is a private laboratory founded in 1992, specialising in the research on broad aspects of mechanisms of weathering and conservation/restoration of natural stone, brick, terracotta and plasters. New technologies of cleaning, desalination, strengthening and water-repellent treatments as well formulation of compatible and adequate restoration mortars, grouts, washes and paints have become the strong areas in laboratory’s activity. The laboratory initially planned to be a full partner to the ROCARE project but had to reduce its role. However, it was vital to involve it as a subcontractor providing a valuable expertise on the compatibility issues of the Roman cement based repair mortars and enhancing market acceptability and commercialisation of Roman cements in Germany, one of the key areas in which the binders were used in the past.

- Atelier Klell in Vienna designed all publications of the past ROCEM project, creating a successful project corporate identity, complementing individual institutional identities of the participating partners. Therefore, it was felt that the previous experience and involvement of Atelier Klell in promoting Roman cements and the built heritage of the nineteenth century would benefit the ROCARE project and facilitate the new tasks of promoting and diffusing the technology.
Peter Butz – Handelsvertretung für bauchemische Produkte und Bauphysik in Neuenrade, Germany has a long experience in the product marketing and application in the building restoration sector which makes it very well qualified to develop the Market Introduction Plan at the initial stage of the project. The plan will analyse in detail the Mainstream Market for Roman cements which is the building restoration and general construction sector and will propose the best strategy to penetrate this market.

B2.4 Resources to be committed

The resources necessary for carrying out the ROCARE project have been adequately planned so that interdisciplinary and challenging project’s objectives are successfully achieved. The planned resources fall into 6 categories: Personnel, Travel, Consumables, Durable Equipment, Sub-contracting and Management. It should be stressed that all partners of the project are well equipped to carry out research tasks which are their responsibility within the ROCARE project. Therefore investment in any durable equipment is particularly low.

The manpower allocated by each partner in various workpackages is reported in detail in the Summary of Staff Effort Forms. The partners are convinced that the qualifications and working time of the scientific and technical staff engaged is adequate to carry out all project’s tasks within the three-year framework.

Travel costs have been carefully planned to make possible all activities important for the management, research and dissemination of the results: participation of all partners in the 5 project progress meetings (PM) and of the steering committee members in 7 executive meetings (EM), 5 of which will coincide with a PM. 650 to 800 euro have been allocated to each partner for such meetings. Further, travels to field and production sites, participation in approx. 5 international conferences to disseminate the results, travels to various destinations to participate in the workshops.

Consumable costs planned comprise software, spare parts, materials and small laboratory equipment necessary to carry out the work. Further on, consumables for producers of Roman cements (partners 11, 12 and 13) consist in raw materials and fuel costs for their kilns. In the case of VFB (partner 13) who needs to construct a kiln for the calcinations of Roman cements, this will be accomplished by handwork – the components are to be regarded as consumables.

Sub-contracting has been limited to few highly specialized tasks confined to relatively short work periods. More details are given in the above list of subcontracted work. The sub-contracting costs are, if ever, always well below 10% of a partner’s budget, with the exception of the coordinator IATCS, who will, for reasons of the management structure, allocate all subcontracts which deal with strategic issues.

Management costs amount to 8.56% of the total of allowable costs.
B3. Impact

B3.1 Strategic impacts

The proposed project is directly focused on achieving impacts listed in the work programme:

This action should contribute to the industrial development of such devices (promising laboratory or pilot-scale prototypes) and facilitate the transfer into the market by SMEs and potential investors.

The industrial development and the transfer into the market of Roman cements, key materials for high-quality restoration of the architectural heritage of the nineteenth and early twentieth centuries, which are an innovative prototype technology developed on a pilot-scale are the principal objectives of the proposed project. The consortium submitting this proposal is convinced that it is capable of achieving these objectives due to the following elements of the project strategy:

- participation of industrial partners, which will produce and optimise production of Roman cements to a competitive level expanding the range of both production technologies and the sources of suitable feedstock
- direct involvement of the end-users – SME restoration companies and an SME specialised in the formulation and distribution of the restoration materials, all active in the heritage sector which will broaden the applicability and the market potential of the developed technology
- direct involvement of the conservation authorities at various levels – national, regional or municipal – which will provide the perspective of the institutions regulating the conservation works and will facilitate local conservation projects to be carried out by the end user group
- high potential demand for the restoration materials based on Roman cements due to very large numbers of the historic buildings decorated with the historic Roman cement stuccoes across Europe and the increasing interest of conservators and heritage managers to carry out the restoration this heritage efficiently, economically and to new high standards
- excellent problem solving abilities of the materials described in detail in part 1.1.2 from the fact that re-established Roman cements are the only historically accurate replacement for the restoration of Roman cement decorations of historic façades, of high durability, excellent compatibility with historic building materials, suitable for a wide range of mortar recipes and of application techniques

B3.1.1 European approach required

Despite their unique features, Roman cements have met entry barriers such as reluctance to leave a known concept, process or product (uncertainty), changeover costs due to change of recipes, additional investments, costs of training staff.

Uncertainty whether the technology works has been a major concern. Indeed, when the technology doesn’t deliver the desired results, the costs spent on restoration are wasted. Even worse - at least from the perception of the potential buyer - the material may cause a detrimental effect on the building, which even might be beyond repair. Previous experience
with the introduction of new materials for conservation purposes has shown that opinion about a novel technology is formed very slowly. Therefore, the ‘we don’t know the material performance’ will be a major entry barrier. The present proposal is focused on addressing this barrier by intensive testing in the conservation practice and presenting the results to the conservation profession in a range of the training and dissemination activities.

The credibility of the new technology and the demonstration of its excellent problem solving potential by their nature can be best addressed at the European level since historic “European Roman Cement” is a concept, rather than a material, having been produced from widely differing local sources of raw materials, which yielded products with a range of properties. This breadth of materials, properties and applications can be recognised only by characterisation of historic mortars from buildings across Europe. Only by considering a broad range of compositions, properties and structures characteristic of “European Roman Cement” can one optimise the manufacture of the binders/mortars, define the range of products which can be obtained and offered, and assess the compatibility between historic and modern materials.

Finally, the proposed work could not be carried out on a local or bilateral level because of limited local/regional expertise, limited local/regional relevance of research and information obtained, limited potential for dissemination of the results and improvement of the current best practice standards. This approach will create confidence among the restoration sector in the whole of Europe, thus enhancing market acceptability and meeting European rather than national standards. This would no doubt help with the dissemination of the project results and post-project commercialisation.

B3.1.2 Other national or international activities

The concept of using re-established Roman cements in the conservation of the built heritage of the nineteenth and twentieth centuries has gained already a considerable interest in Europe and even in the USA. An increasing number of restoration projects in Poland, Austria, Germany, Sweden and Norway have successfully employed the cements. Due to the excellent potentials of the binder, a German supplier of specialised products for building restoration operating all over Europe, decided to add ready mixed Roman cement mortars to their range of products. In Poland, a national project has been focussing on issues important for the practical use of Roman cements in the restoration of building façades.

The proposed project will enhance novel local, national and international activities by involving a large group of the SME end users and conservation authorities in various European countries. These activities will contribute to the growing acceptance of Roman cement technology and the awareness of its breakthrough potential.
B3.2 Plan for the use and dissemination of foreground

The project workplan comprises several activities aimed at an effective promotion and dissemination of advantages of the novel technology in the restoration and construction sector engaged in the restoration of built heritage:

B3.2.1 End-user Advisory Panel

Central in the project will be the effective transfer of the knowledge gained to the decision makers – conservation authorities in various European countries and at various levels – national, regional or municipal. Their representatives will form the project’s Advisory Panel. They will help in launching local restoration projects to demonstrate the use of the novel technology and will contribute to the dissemination of the project findings and results within the respective professional communities.

B3.2.2 Creation of a project website

A public and internal project website will be created and regularly updated for supporting the needs of the consortium management and internal synergy. In parallel it should provide for the widest possible visibility of the project objectives and its results.

The public website of the project will be a central site from which all the work done as part of the project can be found. The site will provide project overviews and highlights; up-to-date information on intermediate and final project results, including public reports; project events, including conferences and workshops; contact details, etc. Web pages regarding the ROCARE project will also be created within the official web sites of the participating organizations in order to increase the visibility of the project.

The internal, password-protected website of the project will be a central site for the ROCARE consortium from which reports, minutes and other internal documents can be found.

Project brochures will be printed and distributed at relevant events.

B3.2.3 Manual on best practice in the application of Roman cements

This manual, both in a printed form and web-based, and freely-available, will present and illustrate all relevant data gained during the project. It will yield guidance to the use of the Roman cement technology in the various fields of application. The Manual will be a key tool to approach the market.

B3.2.4 Workshops

National workshops will be organised in all participating countries, namely a 2-days workshop with hands-on facilities within the last year of the project duration, in order to promote the Roman cement technology. The workshops will be addressed to cultural-heritage stakeholders: owners and curators of historic buildings and collections, public policymakers and national heritage organisations, conservation practitioners and enterprises engaged in
diagnosing and protecting historic buildings and collections, teaching staff and students of the conservation departments.

B3.2.5 International Conference

An international conference on the topic of “Natural Cements” will be organised at the end of project duration. It will offer ample possibilities to inform about the project results, promote the product and discuss its application within the sector of cultural heritage preservation as well as for other possible markets. Invited key-note speakers will come not only from within the project consortium, but also from neighbouring fields of lime, hydraulic lime and cements.

The organisation of that conference will be in the hands of the coordinator. It will be self-financing through participation fees. Proceedings will be published.

B3.2.6 Publication of the results in scientific journals and presentation at congresses

The outcome of the project will be published in peer reviewed journals as well as at congresses.

B3.2.7 Resume

Summing up, the project results will also attain a high visibility for the general public because they can be easily understood and because they concern built heritage which attracts attention from the general public at a European level. The project Partners will aim at publishing and promoting the results not only in specialised professional literature but also in public media, including a project website, and will make use of professional Public Relations offices within Partner institutions.

B3.2.8 Management of intellectual property

Intellectual Property issues will be regulated by the Consortium Agreement to be proposed by the coordinating unit and to be agreed by all partners. Both exploitation rights and confidentiality issues will be addressed. Background knowledge will be identified at the start of the project and documented as annexes to the contract. The partner who generates knowledge owns that particular knowledge. If partners have generated the knowledge jointly, they shall have ownership jointly. Details will be dealt with on a case by case basis. Access rights will be granted in accordance with and subject to the EU contract and the Consortium Agreement.

To avoid merging of pre-existing know-how and know-how generated during the ROCARE project, pre-existing knowledge of the research partners will be investigated and drawn up in the Consortium Agreement. Non-disclosure agreements will be signed by all members of the consortium. Pre-existing know-how will be available for those partners that need this knowledge for being able to carry out their tasks in the project.

Broad dissemination and implementation of project results have been planned.
Public dissemination level

To this category belongs all general scientific and conservation information on the materials, processes and treatments. The user group interested in the results encompasses architects, surveyors, engineers, restoration workers, conservators, administrative bodies and international institutions responsible for the care of historic buildings or working in the field.

In the project several activities are aimed at the effective publicity and transfer of knowledge in the professional community engaged in the management, care and protection of cultural heritage:

- publications in leading conservation journals of international circulation and presentations on international conferences,
- organisation of an international and interdisciplinary workshop
- development and publication of freely-available, web-based *Manual on best practice in the application of Roman cements* to yield guidance to the use of the Roman cement technology in the various fields of application
- incorporating the project results in education and training of conservators and scientists through the partners involved in teaching at different levels.

Restricted dissemination level

To this category belongs scientific information of a fundamental character gained from the on-site and laboratory investigations. This part of the project output is important scientifically and supports the applied research and commercial exploitation of the results. It will be published in scientific journals and as conference contributions, communicated to members of relevant professional communities through usual channels like seminars and private communications. Attention will be paid however by all Partners of the consortium to avoid - at least temporarily - disclosure of the data which can be essential to understand and formulate exploitable results of commercial interest to the partners. A prior notice of any intended publication will be given to all partners to avoid a conflict of interests.

Confidential dissemination level

To this category belongs all information of direct technical relevance which would permit especially the SME partners to build up new or enhance their actual business. Further, other companies or consultants interested in the developed methodologies can be contacted directly at various stages of the project by the individual project partners.

The partners envisage the following strategy to use and exploit the confidential technical information of commercial interest:

- the results capable of industrial or commercial application will be identified and integrated into confidential information packages – technical and test reports
- during yearly meetings the participants will collectively decide on the best strategy to protect and use this confidential information so as not to harm the commercial interests of partners which has developed it

B4. Ethical Issues

The proposed project does not arise any of the ethical issues listed by the Commission.