

EUREKA PROJECT E!2849 - EUROCARE2000 HERIFUND

1. General description

Project	E! 2849 - EUROCARE2000 HERIFUND	Status	Proposal - 13-MAY-2002
Title	Restoration Of Cultural Heritage Buildings By Stabilisation And Hydro-Insulation Of Foundations		
Class	Sub-Umbrella	Technological area	New Materials
Start date	01-JAN-2004	End date	01-JAN-2007
Duration	36 months	Total cost	1.38 Meuro
Partner sought	Yes		
Summary	New Method For Rehabilitation Of Wall Foundations Of Buildings Over 200 Years Old By Stabilisation And Hydro-Insulation. The Proposed Technique Will Be Simpler, Cheaper And Faster Than Existing Methods And Will Have A Reduced Impact On The Environment.		

Budget and duration

Phase	Budget(Meuro)	Duration (Months)
Implementation phase	1.38	36
Total	1.38	36

Member contribution

Member	Contribution	Position	Since
Slovenia	60.88%	Contact Member	13-MAY-2002
Italy	39.12%	Interested	31-OCT-2003

Participants

Company	Country	Type	Role
Ing.Klan Podjetje Za Inzeniring, Proizvodnjo, Trgovino In Storitve D.O.O.	Slovenia	SME	Main

2. Project outline

Project description

In times when nowadays important cultural buildings were built, the builders were primarily interested in the stability of the building, even though they knew that water and humidity are the greatest enemies of materials in buildings. However, the choice of materials was very poor and buildings were constructed without or with weak foundations. That is why many older cultural and historical buildings are very damp and so cold that they cannot be used anymore.

This project is dedicated to a new advanced technological solution of the above problem, namely the stabilization and hydro insulation of the lower part of the walls of the historical buildings. This solution will present an important part of restoration of the building, which will make it dry, healthy and appropriate for use. Through the solution of this project important cultural and heritage buildings will be preserved.

The deterioration of cultural and historical buildings represents huge social damage. This applies to every aspect of the problem: cultural and civil engineering, as well as artistic. The cost of early prevention and care of these monuments is far lower than the cost of repairing the damage. The new technology will meet the requirements of several of the most characteristic earth types and different techniques of wall-construction, it will be more efficient and cheaper, compared to the present ones. The cost of stabilisation and hydro insulation represents approximately one quarter of the total cost of the restoration of historical buildings. Therefore this method represents considerable savings of cost of total restoration.

The proposed HERIFUND project covers the advanced treatment techniques of cultural assets and as such contributes to the implementation of the objectives of umbrella project E! 2694 - EUROCARE 2000, of which HERIFUND project is a sub-project. Namely, the objective of the EUROCARE umbrella project is to support and enable advanced technical standards and European guidelines for evaluation, analysis and treatment of cultural assets. Amongst others, one of its aims is to improve the analytical and treatment techniques to be applied in the conservation sector - exactly what HERIFUND project is proposing.

STATE-OF-THE-ART

The most common method for the stabilisation of walls without foundations has been to construct foundations in the ground by excavation. The building of foundations under walls reaches down to the depth of permafrost (0,8 m to 1 m). In the case of poor foundations with a high moisture content, which act as a conduit for moisture from the ground to the walls, the known technological procedures include sawing and knocking out the walls and then inserting hydro-insulating implants such as horizontal hydro-insulation. A common characteristic of all the above-mentioned solutions is that a horizontal diaphragm prevents capillary moisture coming from the ground. There are a number of ways of constructing a hydro-impermeable layer. The problem is to stabilise an already dilapidated lower wall without a real foundation.

There are several known solutions to the rehabilitation of wall foundations, which are protected under intellectual property rights legislation. The oldest solutions are covered by the patent FR - A- 2321574; 18-03-77. According to this, the horizontal wall insulation is constructed only above the existing part of the building. It is therefore incomplete and does not suit a wall without foundations. Other solutions, such as FR-A 2465038, DE-A-3231353, WO-A-8500395 and DE-A-3434097, do not solve the problem either. Based on the vast experience of participants, which they have gained from practice over three decades, they have envisioned the possibility of developing an advanced technology to improve on the present methods. The particular feature of this technology will be to stabilise strongly deteriorated lower parts of walls that were originally built without any real foundations. This technology will be simpler to use than existing technologies and will cause less burden on the environment. Also, its cost will be approximately 50% lower than existing methods.

OUR APPROACH TO THE PROBLEM

For versatile stability and compactness of the building material, the main participant suggests an injection of a special mineral expansive silicate grout under adequate pressure. The expansive silicate grout, when injected fills all the weak places in the lower part of the wall, as well as the places under the injected part of the foundation to the pebbles.

For the smaller pores and cavities the main participant proposes silicone implants, which are parapremeable and water - repellent. The implants will conserve the mineral building materials in the wall and wall foundations. This procedure is in the process of being patented: Slovene national patent has already been granted, whereas the patent protection has been applied for in the 26 European countries (European Patent). The process for national patent protection has also been started in RUSSIA, POLAND, UKRAINE and CHINA. The patent is based on preliminary laboratory testing on idealised models of earth types and wall construction. Within the research programme of the project, testing will be carried out on models based on data gathered from fieldwork in ITALY and SLOVENIA. This data will include several different characteristic earth types and building techniques in the area.

This new procedure requires only 50% of the depth of excavation compared to that of the process of

under-excavation. By doing so, costs and the environmental burden will be lowered. The time needed for such renovation will also be 50% shorter. Even more, there will be no need during restoration to close the building - it can continue to serve its purpose without any interruption; thus, without losing the income it generates.

The project is divided in the following work packages:

1. The Analysis of the Buildings

Start: Month 1,
Finish: Month 6,
Duration: 6 months.

2. Taking Samples of the Earth Types

Start: Month 2,
Finish: Month 6,
Duration: 5 months.

3. Geo-Mechanical Analysis of the Earth Types

Start: Month 7,
Finish: Month 11,
Duration: 4 months.

4. Optimisation and Adjustment of Grout Injection Process

Start: Month 12,
Finish: Month 33,
Duration: 23 months.

5. Development of the Prototypes and Experimental Research on the Prototypes

Start: Month 12,
Finish: Month 31,
Duration: 21 months.

6. Pre-Competitive Market Research Activities

Start: Month 30,
Finish: Month 36,
Duration: 7 months.

Technological development envisaged

Our goal is to develop a solution to the problem of stabilisation and hydro-insulation by pouring concrete into existing dilapidating foundations of walls and by injecting an expansive mineral silicate grout.

The existing method of under-excavating and building missing foundations is extremely expensive in comparison to this new technology. The envisioned technological development comprises the following research and technological activities:

- Geo-mechanical analysis of the earth types.
- Optimization and adjustment of grout injection process to specific earth and wall types.
- Development of the prototypes and experimental research on the prototypes.
- Pre-competitive market research activities (in the part dealing with Analysis of the results and synthesis of the elements of new technology and dedicated materials; and Guidelines for the use of the new technological procedures and dedicated materials).

The advantages of such developments include:

1. The time period needed for the stabilisation and hydro-insulation of the lower parts of walls will be shortened by approximately 50%.
2. There will be no need for buildings under restoration to be closed. This effectively means that the income flow, generated by use of the building, will not be interrupted. This may be a very important consideration to the owners of buildings in their decision-making process for restoration.
3. The cost of such restoration will be lowered; this is also an important consideration in commissioning the works.
4. 50% reduction in excavation depth; thus, the environmental burden will be reduced.
5. The usual level of moisture in walls is approximately 2%. In the case of dilapidated buildings that require restoration, the level of moisture in walls is up to ten times as much. When the level of moisture in walls reaches 16%, the wall's accumulative ability to be an insulator is entirely lost. If the wall is dried out, it can save up to 50% in energy consumption as the wall retrieves its physical properties of thermo-accumulation and insulation.

To summarise, the new technology will solve both the problems of stabilisation and hydro-insulation of the walls. No present-day technology offers this possibility of solving both problems at the same time. This makes this method unique. When all factors are taken into consideration, it is much more likely that the building owners will chose such a method. By offering affordable (in all terms) restoration, further long-term

NACE

buildings

3. Main participant

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Contact	Dipl. Ing. Ivan Klanecsek Procurator Tel +386 2 42 00 149 Fax klanecsek@ingklan.si
Organisation type	SME
Participant role	Main

Contribution to project

The company has its own research premises (50m²) and specialised equipment necessary for the implementation of the project. In addition, they will use the laboratories at the UNIVERSITIES OF LJUBLJANA and MARIBOR. The company has 7 employees, including engineers, civil engineers, an architect and similar. The following research equipment will be used in the project: - Research equipment for research into concrete solidity; - Research equipment for the separation/ granulation analysis and analysis of earth types and gravel aggregates; - Electronic moisture meters; - Electronic meters for water measurement; - Different scales for precise measurement; - Measuring equipment for indurate concrete; - Fixed and mobile laboratory AQUAMERCK (water supply laboratory for building industry) and research of concrete alloys (biological accumulations with negative influence on building material). ING.KLAN also produces specialised materials and additives. Tasks of main participant: WP I. THE ANALYSIS OF THE BUILDINGS ING.KLAN chooses 3 characteristic buildings in SLOVENIA and also helps ORIOLO pick 10 characteristic buildings in the medieval hamlet of Oriolo. The buildings will be chosen according to their particular characteristics, namely its location, terrain and walls, as well as their use (chapels, castles, monasteries and similar). ING.KLAN then performs the following tasks of the analysis of the buildings in SLOVENIA: - A characteristic description of the buildings, the size of the urbanised area according to the specification prepared beforehand, the size of the complex; - Mapping/scanning and analysing the lower part of the walls of the actual buildings (that were originally built without real foundations); - The description of the existing state and the maintenance of cultural and historical heritage buildings. For this purpose, the main partner will define methodology and parameters in advance; - The description of different ways of financing the maintenance of the buildings; - The possibilities of the exploitation of the renovated buildings. WP II. TAKING SAMPLES OF THE EARTH TYPES Simultaneously with the WP I, the partners will be taking the earth types samples from underneath the buildings (chosen in WP I). ING.KLAN will take 5 from SLOVENIA. If necessary, ING.KLAN will assist ORIOLO in the choice of the earth types. Methodology of the taking of the samples (the manner and quantity of the sample) will be in accordance with the detailed methodology on the matter, already prepared by ING.KLAN Company. The aim of this methodology is to ensure that the samples taken from both ITALY and SLOVENIA are mutually comparable and can be used in the laboratory environment (see WP III for details). WP III. GEO-MECHANICAL ANALYSIS OF THE EARTH TYPES On the three earth type samples from large historical buildings in SLOVENIA, ING.KLAN will perform the following tasks (with assistance of the UNIVERSITY OF LJUBLJANA): - Classification of the earth type as incoherent - fragmentary and coherent or linked. - Analysis of the type of earth structure before and after the compression. - Analysis of the specific gravity of the solid parts of the earth types $p/s = \text{kg/m}^3$. - Analysis of the granulation of mineral consistency of the earth type, which influences the physical quality of this. - Analysis of the porosity and moisture of the earth types and pore quotient. - Analysis of the clay consistency,

plastic, semi-hard or hard condition. - Analysis of the earth type density and relative density. - Analysis of the steam permeability. - Analysis of the compressibility and elasticity of the earth type. It is expected that this analysis will be, at least in some parts, subcontracted to suitable Universities and Research Institutes (possibly UNIVERSITY OF CALABRIA, ITALY, and GEO-MECHANICAL INSTITUTE, SLOVENIA).

Expertise

Engineer Ivan Klanec is presently the senior adviser for technology and research in the company. He is also responsible for the technological and strategic development of the company and is the founder and biggest shareholder of the company. This company has many years of experience in the management of projects, both in technological development as well as projects for the market. Mr Klanec possesses extensive management and marketing skills and references, which he has built up over three decades. This has also led to his position from 1991 to 2002 as President of the SLOVENIAN BUSINESS INNOVATION NETWORK, which has 400 members. The main participant in the project has more than three decades of practical experience in the renovation of historically and culturally valuable buildings. This includes, for example: the Town Hall and Court House in the ancient town of Piran, located on the Adriatic coast; analysis of the present state of the Slovene parliament building and preparation of the project plan for renovation; renovation of the Lyceum building in Ljubljana, which is presently used by the SLOVENIAN MINISTRY OF FOREIGN AFFAIRS. Mr. Klanec has 9 patents in the field of civil engineering, specifically connected to hydro-insulation and renovation of culturally and historically important buildings. He and his company also have 13 protected models for different construction materials and tools. In total, Mr. Klanec has developed 56 separate, different innovations. Contribution: WP IV. OPTIMIZATION AND ADJUSTMENT OF GROUT INJECTION PROCESS The main participant ING.KLAN will carry out calibration of grout injection process. ORIOLO, the other participant, will assist ING.KLAN by supplying them with materials ORIOLO uses in ITALY. 1. Analysis and composition of the expansive mineral grout for injection - Analysis of the kind and quantity of the combining material and additives to the injecting mortar; - Analysis of the filler kinds and definition of D max (maximal diameter of granulate). 2. The definition of the technical technological process of injection - Analysis of the adequacy of the bored injecting probes with regard to the injecting mortar; - Analysis of the time and pressure respectively for each in advance bored injecting probe (search for the optimal parameters of injection - pressure, viscosity, maximum diameters of the particles, etc). WP V. DEVELOPMENT OF THE PROTOTYPES AND EXPERIMENTAL RESEARCH ON THE PROTOTYPES Both partners will produce prototypes - laboratory models of the most typical earth types and wall constructions. The prototypes will be built on the basis of the concept for the research into technical-technological process of stabilisation and hydro insulation of the heritage buildings after the technologically protected invention. 5 prototypes will be built in SLOVENIA and 10 will be built in ITALY in order to recreate many possible varieties of earth type and wall construction. This task is very time-consuming, as the prototypes will take at least 28 days to dry. It is expected that at least last 6 months of this WP will be dedicated to the improvement of technical-technological process. The testing of several different textures of filling, adjusted to the characteristic earth types and walls, will be taking place. After each participant will carry out the main research, suitable research institutes will verify their research findings also. For ING.KLAN, this will be performed by UNIVERSITY OF MARIBOR. WP VI. PRE-COMPETITIVE MARKET RESEARCH ACTIVITIES In order to successfully place the new process on the market, the partner ING.KLAN will perform the following tasks: - Analysis of the results and synthesis of the elements of new technology and dedicated materials; - Guidelines for the use of the new technological procedures and dedicated materials; - Cost analysis of technology application. Besides this, the company is also responsible for the planning of further research, development and business contacts.