

Final activity report

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TYTLE: **Developing Innovative Systems for Reinforced Masonry Walls**

COORDINATOR: Università di Padova (Italy)

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THEMATIC PRIORITY: Horizontal Research activities involving SMEs

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PROJECT COORDINATOR NAME: Claudio Modena

Rev: FINAL



DEVELOPING INNOVATIVE SYSTEMS
FOR REINFORCED MASONRY WALLS

COOP-CT-2005
CONTRACT N. 018120



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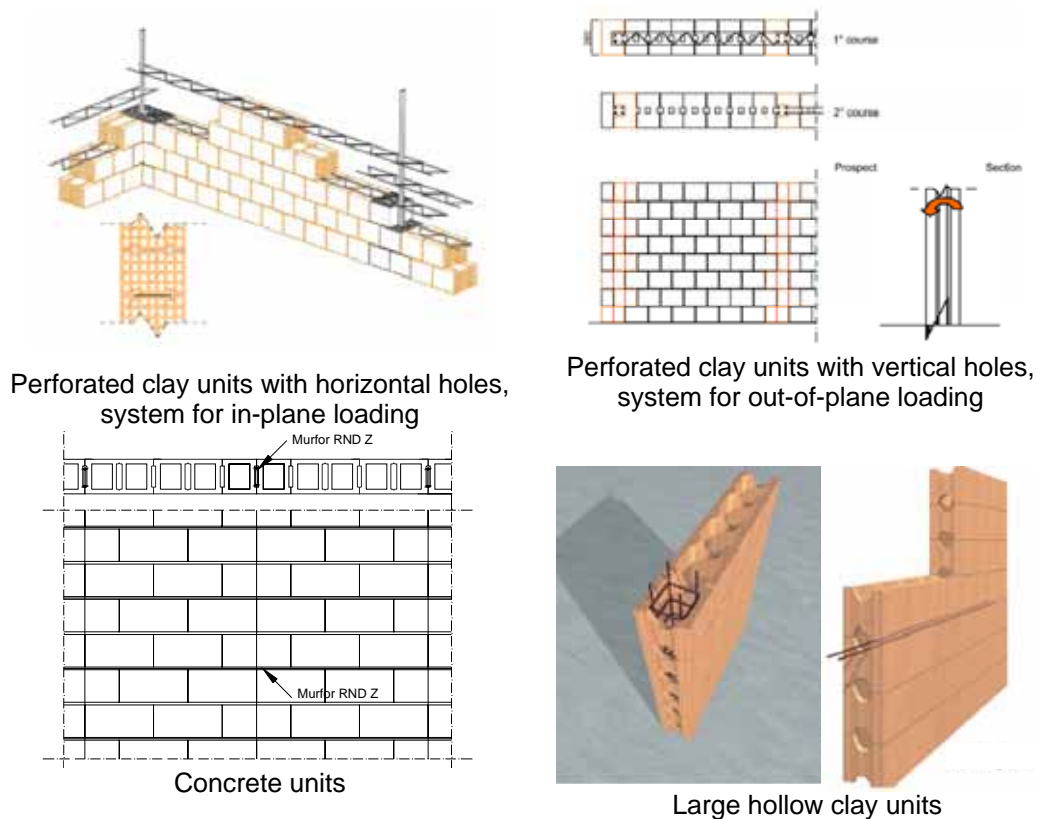
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PUBLISHABLE EXECUTIVE SUMMARY

PROJECT OBJECTIVES

The project aims at developing innovative systems for load and non-load-bearing reinforced masonry walls, based on the advancement of vertical reinforcement and fastening, of mortar and concrete and on their integration with special blocks for the definition of a new constructive system. The adopted approach, from materials through technology and research to case studies, is directed towards product development. The main scientific and technological objectives of the DISWall project are: i) to carry out theoretical studies about the properties and the requirements for masonry units, reinforcement, mortar and concrete for construction of reinforced masonry systems; ii) to develop innovative technologies and building processes for the construction of load-bearing and non-load bearing reinforced masonry walls; iii) to design, manufacture and test the developed prototype products; iv) to experimentally validate the envisaged technological solutions by on-purpose developed testing procedure and to carry out numerical parametrical assessment to define critical mechanical parameters and to assist the optimization of design; v) to carry out theoretical studies on Non-Destructive Evaluation methods to assess the masonry structures and to calibrate the relevant parameters on laboratory specimens and subsequent on-site applications; vi) to develop design rules for the proposed innovative construction systems and for their implementation into software tool and guidelines; and, finally, vii) to transfer the research results into Regulatory and Standardisation Technical Bodies in order to include them into the Structural Codes.

REINFORCED MASONRY WALL CONSTRUCTION SYSTEMS



ACHIEVEMENT DURING THE TWO-YEAR PROJECT DURATION

In synthesis, the major project achievements, which reflect all the expected goals of the project, are:

- The improvement and organization of knowledge about the materials properties and the requirements for masonry units, reinforcement, mortar and concrete, which brought to the creation of a list of minimum requirements needed for the development of new materials, products and reinforced masonry systems;
- the construction of a data-base of experimental results, which stores many available researches and allows organising the knowledge on the mechanical behaviour of reinforced masonry systems, and also enables to carry out comparative assessment on the available data, downloadable from the project website: <http://diswall.dic.unipd.it>;
- the development, design, production and testing of new types of clay and concrete, perforated and hollow units, special mortar and concrete, reinforcement;
- the development of the innovative technologies and building process for the construction of load bearing and non-load bearing reinforced masonry walls, diversified according to the regional environmental conditions and made with the above mentioned materials, and the beginning of testing;
- the development of on-purpose procedure for in-plane and out-of-plane testing of masonry and the laboratory testing, by means of in-plane and out-of-plane testing procedures, of the developed innovative technologies and building process for the construction of load bearing and non-load bearing reinforced masonry walls, which yields to the mechanical characterization and validation of the proposed techniques;
- the calibration and application, in laboratory and on-site, of non destructive testing (NDT) methods to the proposed reinforced masonry typologies, which yields to the definition of quality assessment procedures and methodologies for the evaluation of typical properties and/or defects (covering, etc..) of reinforced masonry buildings;
- the numerical modelling of the tested reinforced masonry walls, with definition of optimal modelling strategies for numerical simulations and the development of parametrical analyses carried out in order to define critical mechanical parameters, to seek for structural limitations/possibilities of the proposed technologies and to assist the tasks of optimizing design;
- the application and development of design rules for the proposed innovative constructive systems and their implementation into software package and design guidelines for a complete applicability of the technology;
- the construction and ND testing of at least one real building and other prototypes and/or similar walls, in order to make also an economic assessment of the proposed techniques, for their complete validation, and to implement the on-site experience into construction guidelines for a complete constructability of the technology;
- the establishment of a proper platform for the dissemination of the project results and the exploitation of the proposed technologies, and the realization of several dissemination actions, through many different types of activities.

CONTRACTORS

N°	LOGO	INSTITUTION/COMPANY	COUNTRY	TYPE	ACRONIM
1		UNIVERSITÀ DEGLI STUDI DI PADOVA http://www.dic.unipd.it	Italy	RTD	UNIPD
2		LATERIZI ALAN METAURO s.r.l. http://www.alanmetauro.com/	Italy	SME	ALAN
3		CIS EDIL s.r.l. http://www.cisedil.it/	Italy	SME	CISEDIL
4		COSTA & ALMEIDA LDA http://www.costaalmeida.pt/	Portugal	SME	C&A
5		TASSULLO S.p.A. http://www.tassullo.it/	Italy	SME	TASSULLO
6		UNIPOR GmbH http://www.unipor.de/	Germany	SME	UNIPOR
7		ANDIL ASSOLATERIZI http://www.laterizio.it/	Italy	OTH	ANDIL
8		BEKAERT N.V. http://www.bekaert.com/	Belgium	OTH	BEKAERT
9		ARBEITSGEMEINSCHAFT MAUERZIEGEL http://www.ziegel.de	Germany	OTH	ZIEGEL
10		RWTH AACHEN INSTITUT FÜR BAUFORSCHUNG http://www.ibac.rwth-aachen.de	Germany	RTD	RWTH
11		TECHNISCHE UNIVERSITÄT MÜNCHEN http://www.mb.bv.tum.de/	Germany	RTD	TUM
12		UNIVERSIDADE DO MINHO http://www.civil.uminho.pt/	Portugal	RTD	UMINHO

CO-ORDINATOR CONTACT DETAILS

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1 PROJECT OBJECTIVES AND MAJOR ACHIEVEMENTS DURING THE REPORTING PERIOD

1.1 PROJECT OBJECTIVES AND CURRENT RELATION TO THE STATE OF THE ART

The main target of the project is the development and rationalization of systems for load and non-load-bearing reinforced masonry walls, in order to obtain quality increase for masonry walls, faster and cheaper construction techniques, crack-free and earthquake resistant construction.

The main general objectives consist in:

- The development of the materials that constitute the reinforced masonry wall systems: brick and block, ties and fastening, mortar and concrete.
- The development of the construction technology for reinforced masonry walls, for better constructability, durability, maintenance, serviceability behaviour (crack reduction) and structural performance (earthquake resistance) of masonry structures.
- The effective integration of the new materials into the production system and of the developed reinforced masonry systems into the construction sector to increase productivity and to obtain economic constructions that can compete with other structural systems.
- The development of quality assessment procedure for reinforced masonry buildings based on the use of NDT methods.
- The contribution to existing and future structural standards by developing guidelines for the application of the new construction systems and for the correct design procedures for the developed masonry typologies, as information tools for end-users.

The project background is clearly constituted by the introduction, during the Seventies of the past century, of reinforced masonry systems in Europe. By placing reinforcement in masonry, a new composite material with high tensile strength is available, which allows to avoid the excessive rigidity of the execution and conception of traditional unreinforced masonry buildings. On the other side, reinforcement placed in non-load-bearing walls allows making crack-free walls and it can also improve the response of the frame in seismic areas, whereas reinforcement placed in load-bearing walls improve the strength and ductility of the structural system, reducing also the risk of disintegration of masonry panels damaged by the earthquake. In this second case, in particular when reinforcement is placed in vertical and horizontal confining elements not designed to perform as resisting frames, also an improvement in the connection between structural walls and an improvement in the stability of slender structural walls is achieved.

Despite reinforced masonry systems show a large variety of benefits, they have not been exploited so much till now in the construction market. The main criticisms that have been raised against these systems regard on one hand the un-easiness of construction and the durability issues, that is problem related to construction, on the other hand issues related to the design methods and to the introduction of more severe code requirements for the constructions. Therefore, the development of faster and more economic reinforced masonry wall systems, easy to build on site, with improved materials to satisfy the more restrictive requirements and to allow for on-site simplification of the operations, the development of numerical studies

and design procedures that allow easier calculation and the exploitation of larger material capacities and the calibration of non-destructive testing techniques for the quality control of the built systems, represent a novelty with large social and commercial impact, rooted with the tradition of masonry construction, which justifies the research effort.

The more detailed objectives through which the achievement of these more general objectives was pursued consist in:

- a. The improvement and organization of knowledge about the materials properties and the requirements for masonry units, reinforcement, mortar and concrete.
- b. The construction of a data-base of existing solutions and the development of the innovative technologies and building process for the construction of load bearing and non-load bearing reinforced masonry walls, diversified according to the regional environmental conditions.
- c. The design, manufacturing and testing of prototype products for the construction of the envisaged innovative systems. The tests involve the single materials and small composite specimens, in order to determinate the main constitutive material laws and to fix design parameters for bond and other relevant materials interactions.
- d. The development of on-purpose procedure for in-plane and out-of-plane testing of masonry specimens and use of the results of testing to improve experimental procedures in the current practice.
- e. The definition of optimal modelling strategies for numerical simulations and use of the results of modelling to improve analysis methods in the current practice.
- f. The experimental validation of the envisaged technological solutions and the determination of constitutive laws to calibrate the numerical models.
- g. The numerical parametrical assessment, carried out in order to define critical mechanical parameters, to seek for structural limitations of the intended technologies and to assist the tasks of optimizing design.
- h. The calibration of NDT for the use on modern masonry and for the evaluation of properties (covering, etc..) typical of reinforced masonry walls; this calibration has to bring to pilot on-site application for the quality assessment of reinforced masonry buildings.
- i. The development of design rules for the proposed innovative constructive systems and their implementation into software package and guidelines for a complete applicability of the technology.
- j. The subsequent transfer of the new solutions and design procedures into codes of practice and structural codes as tools for end-users.
- k. The exploitation and dissemination of the results, quantification of the impact of the project on the ability of the end-users to chose reinforced masonry systems for buildings instead of other construction systems.

In particular, the objectives a) to d) constituted the basic objectives during the first reporting period, the objectives e) to i) constituted the basic objectives for the second reporting period, the objective j) and k) have been already started during the second project year, but will also have a larger time lapse of application after the project end.

1.2 WORK PERFORMED AND ACHIEVEMENTS DURING THE FIRST REPORTING PERIOD

In synthesis, most of the work performed in the first reporting period has concerned the improvement and organization of knowledge about the materials properties and the requirements for masonry units, reinforcement, mortar and concrete, the design, manufacturing and testing of prototype products for the construction of the envisaged innovative systems, the definition of the test programmes and tests procedures. The major achievements were:

- the data base of experimental results;
- the creation of new types of units, mortar and concrete, reinforcement;
- the list of requirement for further material improvement;
- the creation of different types of new reinforced masonry systems;
- the development of on-purpose procedure for in-plane and out-of-plane testing of masonry;
- the dissemination of the project aims and structure and the first dissemination of some project results, as reported in the Annex – Plan for using and disseminating the knowledge, also through the project website: <http://diswall.dic.unipd.it>.

1.3 WORK PERFORMED AND ACHIEVEMENTS DURING THE SECOND REPORTING PERIOD

In synthesis, most of the work performed during the second reporting period has concerned the execution of extensive experimental campaigns on the different proposed reinforced masonry systems, by means of both destructive and non destructive tests, the numerical modelling of the reinforced masonry walls by means of different modelling tools, the application, improvement and implementation into software tools of design procedure for the proposed reinforced masonry systems, the construction of a real building and other walls and the definition of design and construction guidelines. The major achievements were:

- the laboratory (in-plane and out-of-plane) testing of the different reinforced masonry systems;
- the non destructive testing, with calibration and definition of proper techniques, of the different reinforced masonry systems;
- the numerical modelling, with definition of proper modelling techniques and execution of parametric analyses, of the different reinforced masonry systems;
- the definition of design rules, their implementation into a software package and guidelines;
- the construction of one real building and other prototypes and/or similar walls and the development of construction guidelines;
- the dissemination of the project results, as reported in the Annex – Plan for using and disseminating the knowledge, and the creation of a platform for the project result exploitation.

2 WORKPACKAGE PROGRESS DURING THE TWO-YEAR PROJECT

The aim of this section is to provide an overview of the actions carried out during the two year duration of the project and of the results obtained in relation with the initial project objectives. As can be seen from the following scheme (Figure 1), apart for WP1 and WP3 – Product development that run throughout the entire project, most of the other Work Packages had already started during the first year, WP2 – Dissemination and Exploitation, WP4 – Construction Technology, WP5 – Experimental and numerical characterization and WP6 – Design of masonry walls. WP7 was the only one to start during the second project year, in the thirteenth project month. Due to some delays experienced in WP5 and WP6 during the first project year, these two Work Packages were intensively active during the second project year, and ran till the end of the project together with the others (see Figure 2). This allowed to absorb the small delays and carry out in due time all the work described into the DoW.

	YEAR 1	YEAR 2
WP1	Project Management	
WP2		Dissemination/Exploitation
WP3	Product development	
WP4	Construction technology	
WP5	Experimental and numerical characterisation	
WP6		Design of masonry walls
WP7		Prototypes

Figure 1: Schematic Project Workplan after the end of the project.

	YEAR 1	YEAR 2
WP1	Project Management	
WP2		Dissemination/Exploitation
WP3	Product development	
WP4	Construction technology	
WP5	Experimental and numerical characterisation	
WP6		Design of masonry walls
WP7		Prototypes

Figure 2: Updated Project Workplan after the end of the first year.

2.1 WP1 – PROJECT MANAGEMENT

2.1.1 Workpackage objectives

The objectives of WP1 can be summarized as following:

- To perform the global scientific management of the project and co-ordinate single work-packages.
- To co-ordinate the flow of information among partners and relevant input/output between WPs.
- To prepare progress report and final report.
- To create a dedicated website with public and private access for communication and exchange of information among partners. To publish and manage a database on the web site.

The work in WP1 started from the beginning of the project, in PM1, and continued throughout the duration of the project.

2.1.2 Progress towards objectives

The management issues will be discussed in detail in Section 3.

2.1.3 Deviations from the project workprogramme

There were no major deviations from the project workprogramme. All the objectives, related to the general coordination of the project, were fully achieved. The list of deliverables and the list of milestones will be presented in section 3.

2.2 WP2 – DISSEMINATION AND EXPLOITATION

2.2.1 Workpackage objectives

The objectives of WP2 can be summarized as following:

- Promotion of the results to relevant end-users and decision-makers (contractors, developers, architects and engineers) in EU through: (a) guidelines on how to design walls, (b) compared economical studies with respect to other techniques; (c) description of the case studies.
- Promotion of the results to the industry (mainly SMEs) and decision-makers through the organisation of local Workshops in each country. Promotion of the results to students, professionals and scientist by means of lectures, training courses, publications and seminars.
- Promotion of the results to the general public through participation in annual construction fairs such as CONCRETA (Porto), BAU (2005 then every two years in Southern Germany) and DEUBAU (2006 then every two years in Western Germany, BATIMAT (Paris), SAIE (Bologna)
- Promotion of the results in standardisation and regulatory communities (CEN, CIB, RILEM, etc.)
- Commercial exploitation opportunities and SMEs marketing.

The work in WP2 started during the first project year, in PM9. The starting point at the beginning of the first year was the creation of a comprehensive frame for the planning and monitoring of the dissemination activities (D2.2), the creation of a platform for the exploitation (D2.3), and the preparation of an abstract of the project (D2.1), for a global dissemination policy. During the second project year, a more detailed platform for the exploitation was created (contained in D2.4b). Furthermore, many dissemination activities (contained in D2.4a) were carried out.

2.2.2 Progress towards objectives

The work in the field of the dissemination was very intensive and was planned and monitored by means of the comprehensive frame for dissemination actions has been developed by ANDIL. The work is described in detail into the deliverable D2.2 and D2.4a. Some of the main actions carried out from the beginning of the project, January 2006, till the end of the project in January 2008 are:

- Creation of an internet platform, at <http://diswall.dic.unipd.it>
- Presentation of the project at the European standardization body, at CEN TC 250, EC6 committee (Sept. 2006; UNIPD);
- Presentation of the project at the Italian standardization body, UNI (Sept. and Nov. 2007; some indication arising from the project have been already used in the publication of the new Italian Structural Code, the DM 14/01/08) and other standardization committees;
- Presentation at the 43rd CIB Meeting “Wall structures” in Portugal (Oct. 2006; UMINHO).
- Presentation of the first results at the 44th CIB Meeting “Wall structures” in Paris (Oct. 2007);
- Presentation of the project at the Portuguese Construction fair CONCRETA (Oct. 2007), the Italian Construction fair SAIE (Oct. 2007), and other fairs;

- Organization of a relevant seminar on reinforced masonry in Portugal (Nov. 2007) and organization of other technical seminars and workshop in Italy and in Germany during the duration of the year;
- Presentation at the 7th International Masonry Conference in London (Nov. 2006; UNIPD).
- Presentation at the 10th North American Masonry Conference in S. Luis, US (June 2007);
- Dissemination also at academic level to future designers, through training and academic courses (Germany, Italy);
- Publication of several papers on technical and peer reviews and books (Verlag Ernst und Sohn and others), on conference proceedings (10th North American Masonry Conference, US; Sismica 2007, Portugal, etc) and press events on the bulletins of the industrial associations (Arge Mauerziegel (March and April '07), the bulletin of ANDIL (February, Sept. and Oct. '07)).

Other activities have been also carried out in the framework of WP2, as can be found in D2.4. However, from this short list, it is clear that the promotion of the project results has been pursued in all the relevant sectors of interest: standardisation and regulatory communities; end-users, decision-makers and industry; training and research world; general public.

Furthermore, a platform for the exploitation has been developed by ANDIL, by means of different structures:

- a frame for managing in brief the exploitation of the all project knowledge and results, where the knowledge/products/measures are listed and for each of them the type of result they are, the sector of application, the timetable for commercial use and the partner involved are listed;
- a 'free frame' to carry out the economical assessment of the proposed reinforced masonry system, in order to have available information about the economic aspects related to the construction;
- a 'free frame' for each of the participating SMEs to create their own detailed action plans;
- finally, a frame for the exploitation of the project knowledge and results from RTD and OTH partners.

The reporting made by using these above mentioned structure lead to the compilation of the report D2.4b, 'Exploitation final report', where also an economical assessment of the developed constructive systems is reported and the future marketing of the SMEs is planned. The dissemination activities carried out and the exploitation plan demonstrate the effort of the partners for the effective integration of the new materials into the production system and of the developed reinforced masonry systems into the construction sector, which is one of the main objectives of the project described in section §1.1. Also the detailed objectives k), described in section §1.1, was fully achieved.

2.2.3 Deviations from the project workprogramme

There were no major deviations from the project workprogramme.

2.2.4 List of deliverables

D2.1: 'Project presentation' is completed.

D2.2: 'Dissemination plan' is completed.

D2.3: 'Exploitation plan' is completed.

D2.4: 'Dissemination and exploitation final report' is completed and composed of two documents, one related to the dissemination (D2.4a) and the other to the exploitation (D2.4b).

List of deliverables for WP2, including due date and actual submission date.

Del. no. 1	Deliverable name	WP no.	Date due	Actual/ Forecast delivery date	Estimated indicative person-months	Lead contractor
D2.1	Project presentation	2	PM9 Oct. 2006	PM9 Oct. 2006	1.5	ANDIL
D2.2	Dissemination plan	2	PM12 Jan. 2007	PM12 Jan. 2007	4	ANDIL
D2.3	Exploitation plan	2	PM12 Jan. 2007	PM12 Jan. 2007	4	ANDIL
D2.4	Dissemination and exploitation final report	2	PM24 Jan. 2008	PM24 Jan. 2008	12	ANDIL

2.2.5 List of milestones

M2.1: 'Initial dissemination and exploitation plan' is reached 100%.

M2.2: 'Achievement of a favourable platform for exploitation' is reached 100%.

M2.3: 'Organisation of at least three workshop' is reached 100%.

List of milestones for WP2, including due date and actual achievement date

Mil. no.	Milestone name	WP no.	Date due	Actual delivery date	Lead contractor
M2.1	Initial dissemination and exploitation plan	WP2	PM12 Jan. 2007	PM12 Jan. 2007	ANDIL
M2.2	Achievement of a favourable platform for exploitation (final diss. and expl. plan)	WP2	PM24 Jan. 2008	PM24 Jan. 2008	ANDIL
M2.3	Organisation of at least three workshop with industry and practitioners, dispersion of the experience to developers, engineers and architects through training courses, workshops, seminars, symposia, etc..	WP2	During whole Project	During whole Project	ANDIL

2.3 WP3 – PRODUCT DEVELOPMENT

2.3.1 Workpackage objectives

The objectives of WP3 are summarized in the following:

- to develop the suitable units, to define their main design parameters and to produce the number of units required for testing and case studies;
- to define the main design parameters of the reinforcement and fastenings, and to produce the steelwork required for testing and case studies;
- to develop a special purpose mortar and a self-compacting concrete, taking into account in particular workability and flow properties;
- to test the single materials and small composite specimens, in order to determinate the main constitutive material laws and to fix design parameters.

Three main types of masonry, based on the use of three different types of units, were developed in the framework of the DISWall project. The three approaches can be synthesized as following:

- Perforated clay units,
- Large hollow clay units,
- Concrete units.

The work in WP3 started during the first project year, in PM1. The starting point at the beginning of the project was the identification of the minimum requirements and main design parameters for the materials (contained in D3.1), in order to guide the development of the units, mortar and concrete and the reinforcement and fastenings, and the subsequent design of the prototypes product (D3.2; D3.3) for the project aim. The description of the development and the further development of the products during the project, on the basis of the experimental tests and the numerical simulation carried out, and on the basis of the experience on masonry walls built with the developed materials, is contained into the final report (D3.4).

2.3.2 Progress towards objectives

At the beginning of the project, a comprehensive compilation of the current requirements on the masonry units (clay units, hollow units, concrete units), concrete, mortar and reinforcement was done, and resulted in the preparation of D3.1. This deliverable was necessary to guide the product development and is a public report that can be used freely for the design and development of new products in the field of structural masonry. Afterwards, following the above mentioned three approaches, new products were ideated, designed and produced: different types of perforated clay units, with vertical and horizontal holes, hollow clay unit for concrete infill, concrete units with different types of head joints and geometry. A self compacting concrete for the hollow clay unit masonry was developed. Two new mortars were developed to be used expressly with perforated clay units and concrete units. Innovative reinforcement systems produced by BEKAERT were designed and applied (D3.2). These products were intensively modelled and tested, alone and in conjunction with the other materials that compose the masonry walls, in order to derive their properties and to guide their further development, which for some of the proposed materials yielded to new products during the course of the project (D3.3). These processes of development, updating, modelling,

testing were described at the end of the project into the D3.4. The general objective of developing new materials and the more detailed objectives a) and c), described in section §1.1, were thus fully achieved.

2.3.3 Deviations from the project workprogramme

There were no major deviations from the project workprogramme.

2.3.4 List of deliverables

D3.1: 'Report about the requirements for masonry units, reinforcement, mortar and concrete' is completed.

D3.2: 'Prototype masonry units, reinforcement and fastenings, mortar and concrete' is completed.

D3.3: 'Delivery of updated products for prototype construction' is completed.

D3.4: 'Product development final report' is completed.

List of deliverables for WP3, including due date and actual submission date.

Del. no. ¹	Deliverable name	WP no.	Date due	Actual delivery date	Estimated indicative person-months	Lead contractor
D3.1	Report about the requirements for masonry units, reinforcement, mortar and concrete	3	PM6 July 06	PM6 July 06	8	RWTH
D3.2	Prototype masonry units, reinforcement and fastenings, mortar and concrete	3	PM12 Jan. 07	PM12 Jan. 07	20	RWTH
D3.3	Delivery of updated products for prototype construction	3	PM18 July 07	PM18 July 07	10	RWTH
D3.4	Product development final report	3	PM24 Jan. 08	PM24 Jan. 08	6.5	RWTH

2.3.5 List of milestones

M3.1: 'First prototype of newly developed masonry units, reinforcement and fastenings, mortar and concrete design, associated with the constructive technology' is reached 100%.

M3.2: 'Final developed products: masonry units, reinforcement and fastenings, mortar and concrete design' is reached 100%.

List of milestones for WP3, including due date and actual achievement date.

Mil. no.	Milestone name	WP no.	Date due	Actual delivery date	Lead contractor
M3.1	First prototype of newly developed masonry units, reinforcement and fastenings, mortar and concrete design, associated with the constructive technology	WP3	PM12 Jan. 07	PM12 Jan. 07	RWTH
M3.2	Final developed products: masonry units, reinforcement and fastenings, mortar and concrete design	WP3	PM24 Jan. 08	PM24 Jan. 08	RWTH

2.4 WP4 – CONSTRUCTION TECHNOLOGY

2.4.1 Workpackage objectives

The main objective of WP4 is to develop feasible construction systems for reinforced masonry walls by using suitable masonry materials (designed in the framework of WP3) and by developing the new systems starting from traditional construction techniques. Besides the technical validation of the construction, which will be carried out by experimental testing as part of WP5, WP4 is also intended to evaluate the economical feasibility of the envisaged systems. The objectives can be thus summarized as in the following:

- develop adequate and feasible systems (construction technology) for reinforced masonry wall;
- assess total costs (in particular productivity / workmanship) of the newly developed solutions.

The work in WP4 started during the first project year, in PM3. The main activity in this workpackage consisted in interacting with the WP3 for the aim of ideating and designing the new construction systems (D4.1), which were mainly completely designed by the end of the first project year. Through construction of specimens (as demonstrated in D4.2), testing and cost-analysis, it was possible to achieve a complete validation, under the economical, technical, and feasibility point of views, of the proposed constructive systems, contained in D4.3.

2.4.2 Progress towards objectives

The work carried out in this work package can be summarized in the following steps; a) proposal of the masonry wall systems; b) ideation of the construction technology; c) validation of the technical and economical feasibility. The work in this workpackage, therefore, was strictly related to the work in WP3, as the masonry wall systems integrate the different products. The first step was that of proposing and developing, on the bases of the above mentioned approaches, different new reinforce masonry systems. Three main categories of masonry walls were propose: based on the use of perforated clay units, of hollow clay units and concrete units, with some variants (vertically or horizontally perforated clay units; two or three cells concrete units). At the end of the first years all the systems had been designed (D4.1) and some specimens for testing had been already built (D4.2). The following activities of building specimens (in the framework of WP4), testing and modelling (in the framework of WP5), building real or prototype constructions 8in the framework of WP7) allowed gaining much information on these systems. Therefore, it was possible to validate them under the different points of view of the constructability, the technical aspects, and the economical aspects. All the different systems are sound, foir some of them there is also a clear advantage over competing construction techniques such as reinforced frame with masonry infills, in the case of the hollow clay units the system is still slightly expensive in terms of material costs, even if the construction process is made easier and faster. The general objective of developing new construction technologies for reinforced masonry walls, described in section §1.1, was thus fully achieved.

2.4.3 Deviations from the project workprogramme

There were no major deviations from the project workprogramme.

2.4.4 List of deliverables

D4.1: 'Report about the construction processes ideated and the feasibility of the proposed technologies' is completed.

D4.2: 'Practical demonstration of wall construction' was carried out on 24/01/2007 in Guimarães, during the Mid-Term meeting. The deliverable is thus completed.

D4.3: 'Final report about the proposed technologies' is completed.

List of deliverables for WP4, including due date and actual submission date.

Del. no. ¹	Deliverable name	WP no.	Date due	Actual delivery date	Estimated indicative person-months	Lead contractor
D4.1	Report about the construction processes ideated and the feasibility of the proposed technologies	4	PM12 Jan. 07	PM12 Jan. 07	26	C&A
D4.2	Practical demonstration of wall construction	4	PM12 Jan. 07	PM12 Jan. 07	1	C&A
D4.3	Final report about the proposed technologies	4	PM24 Jan. 08	PM24 Jan. 08	7.5	C&A

2.4.5 List of milestones

M4.1: 'Demonstration about the feasibility of the proposed technologies' is reached 100%.

M4.2: 'Construction technology, associated with new materials' is reached 100%.

List of milestones for WP4, including due date and actual achievement date

Mil. no.	Milestone name	WP no.	Date due	Actual delivery date	Lead contractor
M4.1	Demonstration about the feasibility of the proposed technologies	WP4	PM12 Jan. 07	PM12 Jan. 07	C&A
M4.2	Construction technology, associated with new materials	WP4	PM24 Jan. 08	PM24 Jan. 08	C&A

2.5 WP5 – EXPERIMENTAL AND NUMERICAL CHARACTERIZATION

2.5.1 Workpackage objectives

The main objective of WP5 is to provide the mechanical validation of the proposed construction systems by means of experimental work, in order to obtain information on the mechanical properties of masonry and behaviour of reinforced masonry walls. These mechanical data are used in the numerical simulations aimed at defining numerical strategies suitable for the analysis of reinforced masonry walls and at carrying out parametrical assessment of the envisaged construction systems. Finally, the calibration and application of different non destructive testing methods (NDT) is used for the evaluation of the construction quality. The objectives are thus summarized as in the following:

- to improve existing laboratory tests methods and to calibrate and apply NDE methods to reinforced masonry walls;
- to perform the necessary experiments to characterise the experimental behaviour of the masonry walls and to obtain the mechanical data relevant for the numerical simulation;
- to numerically simulate the experimental behaviour of the masonry beams and walls using both vertical and horizontal reinforcement;
- to perform sensitivity studies about the influence of material data on the response of masonry walls;
- to perform a parametric assessment to seek for structural limitations.

The work in WP5 started during the first project year, in PM3. The starting point at the beginning of the work was a literature survey to collect all the available information on laboratory testing methods (reported in D5.1) and non destructive evaluation techniques (reported in D5.2). After this survey, the testing programmes required to properly characterize the proposed masonry systems and to test the NDE methods application were clearly defined, and some special laboratory test procedure were adopted or proposed. During the second year, the testing programmes were completed (destructive tests, reported in D5.5, and non destructive tests, reported in D5.6) and the numerical modelling and parametric assessment was carried out (reported in D5.4).

2.5.2 Progress towards objectives

The work carried out in this work package can be summarized in the following steps; a) proposal of the laboratory testing programme, construction of the specimens and their testing; b) proposal of the NDE testing programme, construction of the specimens and their testing; c) definition of a modelling strategy and carrying out of numerical and parametrical analyses. The literature survey to collect all the available information on laboratory testing methods (reported in D5.1) was aimed at clarifying existing experimental approaches used in the characterization of the in-plane and out-of-plane behaviour of unreinforced and reinforced masonry walls. On the basis of this survey, new or updated testing methods were proposed, in the framework of the research, to tests both materials and masonry elements. In particular, two types of tests (out of plane and in plane) were carried out on a number of masonry specimens of the different typologies, adopting different procedures according to the aim of the tests. The literature survey also gathered information on the experimental non destructive techniques (reported in D5.2) commonly used for the

inspection of unreinforced masonry structures, in order to select different feasible methods to be calibrated and used in the control of construction quality of different types of reinforced masonry walls and to define strategies for the application of the more adequate non destructive techniques. In particular, several tests were carried out by means of radar, sonic and ultrasonic tests, infrared thermography, impact echo and magnetic covermeter. After this survey, the testing programmes required to properly characterize the proposed masonry systems and to test the nde methods application were clearly defined, and a demonstration was held at the Mid-Term meeting (D5.3). From the mechanical tests, it came out that, generally, the proposed technologies are all sound, and, in certain cases, some improvement were already proposed. The non destructive tests presented some limitation in their application on reinforced masonry. In any case, it was possible to select the best technique for each application and to identify the possible calibration to be carried out. The mechanical tests also allowed obtaining all the relevant information to carry out detailed numerical simulation of the tested systems. Different approaches were selected for the analyses and a number of calculations, also useful for the parametric assessment needed for the WP6, were carried out. The general objective of developing quality assessment procedure for reinforced masonry walls and the more detailed objectives d), e), f) and g) (in cooperation with WP6) and h) (in cooperation with WP7), described in section §1.1, were thus fully achieved.

2.5.3 Deviations from the project workprogramme

There were no overall deviations from the project workprogramme.

2.5.4 List of deliverables

D5.1: 'Report about the existing methods for cyclic in-plane and out-of plane testing and their development for the project aims' is completed.

D5.2: 'Report about the existing NDE methods suitable for masonry inspection, and their parameter to be calibrated for the purpose' is completed.

D5.3: 'Laboratory demonstration of DT and NDT methods', was carried out on 24/01/2007 in Guimarães, during the Mid-Term meeting. The deliverable is thus completed.

D5.4: 'Report about the accuracy and reliability of the numerical simulations, the agreement between experimental and numerical results, and guidelines for optimal modelling strategies' is completed.

D5.5: 'Technical report with the experimental results on materials and masonry walls' is completed.

D5.6: 'Technical report with the experimental results of NDE methods applied to masonry walls', is completed.

List of deliverables for WP5, including due date and actual submission date.

Del. no. ¹	Deliverable name	WP no.	Date due	Actual delivery date	Estimated indicative person-months	Lead contractor
D5.1	Report about the existing methods for cyclic in-plane and out-of plane testing and their development for the project aims	5	PM9 Oct. 06	PM9 Oct. 06	6	UMINHO
D5.2	Report about the existing NDE methods suitable for masonry inspection, and their parameter to be calibrated for the purpose	5	PM9 Oct. 06	PM9 Oct. 06	7	UMINHO
D5.3	Laboratory demonstration of DT and NDT methods	5	PM12 Jan. 07	PM12 Jan. 07	1	UMINHO
D5.4	Report about the accuracy and reliability of the numerical simulations, with guidelines for optimal modelling strategies	5	PM15 Apr. 07	First draft PM18; Completed PM24 Jan.08	7	UMINHO
D5.5	Technical report with the experimental results on materials and masonry walls, the agreement between experimental and numerical results	5	PM15 Apr. 07	First draft PM18; Completed PM24 Jan.08	24	UMINHO
D5.6	Technical report with the experimental results of NDE methods applied to masonry walls	5	PM18 July 07	First draft PM18; Completed PM24 Jan.08	8.5	UMINHO

2.5.5 List of milestones

M5.1: 'Mechanical data relevant for the characterization of the experimental behaviour of the masonry systems, enlargement of the existing database, numerical simulation of the experimental behaviour of the masonry walls and sensitivity studies and assessment ...' is reached 100%.

M5.2: 'Calibration of NDE methods for on-site application to real buildings' is reached 100%.

List of milestones for WP5, including due date and actual achievement date

Mil. no.	Milestone name	WP no.	Date due	Actual delivery date	Lead contractor
M5.1	Mechanical data relevant for the characterization of the experimental behaviour of the masonry systems, enlargement of the existing database, numerical simulation of the experimental behaviour of the masonry walls and sensitivity studies and assessment ...	WP4	PM18 July 07	PM24 Jan. 08	UMINHO
M5.2	Calibration of NDE methods for on-site application to real buildings	WP4	PM24 Jan. 08	PM24 Jan. 08	UMINHO

2.6 WP6 – DESIGN OF MASONRY WALLS

2.6.1 Workpackage objectives

The main objective of WP6 is to develop understandable, easy to use, unambiguous, accurate and sound design guidelines to be used with the intended technology. The objectives can be thus summarized as in the following:

- to carry out parametric study under variation of the relevant parameters (geometry, material, reinforcement, loadings, boundary conditions...) using numerical simulation to provide design charts;
- to provide guidelines for end users and practitioners regarding the construction and design of masonry walls with vertical and horizontal reinforcement;
- to provide also simple software tools for the design of masonry walls made with the envisaged technology (SoWall).

The work in WP6 started during the first project year, in PM9. The starting point at the beginning of the workpackage was the integration of the work already done in D1.2 (literature survey of experimental data and assessment through the data base of existing design formulations for perforated clay and hollow concrete units reinforced masonry) for the scope of WP6. The main work of the WP6 was carried out during the second year, and included the elaboration of design chart for the proposed reinforced masonry system (D6.1), the implementation of design rules for the proposed masonry system into a software package for wall verification (D6.3) and the preparation of design guidelines (D6.2).

2.6.2 Progress towards objectives

The work carried out in this work package can be organized in the following steps: a) assessment of the existing design procedures; b) numerical modelling to carry out parametric study and elaborate design charts; c) elaboration of design guidelines; d) preparation of software tools for reinforced masonry walls assessment. The parametric analyses carried out by means of the numerical tools selected and used in WP5 allowed better evaluating tests results and selecting proper design formulations for the proposed systems. Therefore, still based on the three above mentioned approaches, and for the relevant out-of-plane and in-plane loads, proper design formulations were selected or were developed and were applied to produce design charts (D6.1), which the end-user can use directly for the design of the reinforced masonry walls. The charts were introduced into comprehensive design rules, where the rationales for the design of the proposed systems are explained (D6.2). This public report will be thus very useful for the end-users. Finally, a Software Code for in-plane and out-of-plane loadings was prepared, in order to allow the fast verification of the reinforced masonry wall sections (D6.3). The general objective of contributing to existing and future standards and the more detailed objectives g) (in cooperation with WP6) and i) and j), described in section §1.1, were thus fully achieved.

2.6.3 Deviations from the project workprogramme

There were no overall deviations from the project workprogramme.

2.6.4 List of deliverables

D6.1: 'Design charts for typical spans, loading, boundary conditions and materials' is completed and inserted in form of charts into the D6.2.

D6.2: 'Guidelines on the design for end-users' is completed.

D6.3: 'Software code for wall design' is completed.

List of deliverables for WP6, including due date and actual submission date.

Del. no. ¹	Deliverable name	WP no.	Date due	Actual delivery date	Estimated indicative person-months	Lead contractor
D6.1	Design charts for typical spans, loading, boundary conditions and materials	6	PM15 April 07	First draft PM18; Completed PM24 Jan.08	13.5	TUM
D6.2	Guidelines on the design for end-users	6	PM18 July 07	First draft PM18; Completed PM24 Jan.08	12	TUM
D6.3	Software code for wall design	6	PM24 Jan. 08	PM24 Jan. 08	12	TUM

2.6.5 List of milestones

M6.1: 'Design chart and design guidelines' is reached 100%.

M6.2: 'Design software' is reached 100%.

List of milestones for WP6, including due date and actual achievement date

Mil. no.	Milestone name	WP no.	Date due	Actual delivery date	Lead contractor
M6.1	Design chart and design guidelines	WP6	PM18 July 07	PM24 Jan. 08	TUM
M6.2	Design software	WP6	PM24 Jan. 08	PM24 Jan. 08	TUM

2.7 WP7 – CONSTRUCTION AND TESTING OF PROTOTYPES

2.7.1 Workpackage objectives

The main objective of WP7 is to incorporate the constructor's viewpoint in the definition of the technology, by means of real case-studies and prototypes, in order to develop easy to use and accurate construction guidelines and to assess the reliability of the proposed NDE testing methods on site to give quality control tools to the end-users. The objectives can be thus summarized as following:

- to design and construct prototype walls with the proposed reinforced masonry system, in order to assess the feasibility under real on-site conditions;
- to make the on-site assessment of the prototype walls with in situ non-destructive testing, to check both the applicability of the NDT to real case study and to assess the real case execution
- to address the construction requirement and the real case application of the technology in order to enclose the constructor viewpoint into the final construction guidelines.

The work in WP7 started during the second project year, in PM13. The starting point was the study of the possible construction typologies that can be built applying the developed systems, in order to define target applications and overall requirements, and the selection of the proper building where applying the new technology (D7.1). After that, the main work of the WP7 consisted in the design and construction of the prototype walls (D7.2), the application of NDE techniques on the prototype walls (D7.3, D7.4) and the preparation of the construction guidelines (D7.5).

2.7.2 Progress towards objectives

The work carried out in this work package can be summarized into the following steps: a) proposal of the real case study; b) design and construction of the prototype walls; c) application of NDE techniques to the real case study; d) definition of construction guidelines. The first point led to the decision of applying one of the newly developed technologies (reinforced masonry made with vertically perforated clay units) on a construction site in Italy, more precisely on the Lake Garda (D7.1). Moreover, a number of other real-scale/prototype/etc. walls were built in the framework of the project. The design and construction (D7.2) of these walls allowed sharing information with the WP6 (design) and gaining important information to be included into the construction guidelines (D7.5). Moreover, the non-destructive tests calibrated and applied in laboratory in the framework of WP5, were also applied on site (D7.3). The results are reported in D7.4, and are very interesting as they did not simply allowed to evaluate the construction quality, but also to better define limitations and possibilities of some of these techniques, in order to create procedures of ND assessment for reinforced masonry walls. The detailed objectives h) (in cooperation with WP7), described in section §1.1, were thus fully achieved.

2.7.3 Deviations from the project workprogramme

There were no major deviations from the project workprogramme.

2.7.4 List of deliverables

D7.1: 'Individuation of the proper building where applying the new technology' is completed.

D7.2: 'Prototype walls design and construction' is completed.

D7.3: 'Demonstration of ND testing on real masonry walls' was carried out on site during the last three project months and was exhibited in form of a video on 11/01/08 in Padua, during the Final Project Meeting. The deliverable is thus completed.

D7.4: 'Report on in situ testing, with definition of NDE methods for quality control and on adequacy of the execution technology' is completed.

D7.5: 'Guidelines for site organisation and execution' is completed.

List of deliverables for WP7, including due date and actual submission date.

Del. no. ¹	Deliverable name	WP no.	Date due	Actual delivery date	Estimated indicative person-months	Lead contractor
D7.1	Individuation of the proper building where applying the new technology	7	PM12 Jan 07	PM18 July 07	3	CISEDIL
D7.2	Prototype walls design and construction	7	PM18 July 07	PM18 through PM24 Jan.08	8	CISEDIL
D7.3	Demonstration of ND testing on real masonry walls	7	PM24 Jan. 08	PM24 Jan. 08	1.5	CISEDIL
D7.4	Report on in situ testing, with definition of NDE methods for quality control and on adequacy of the execution technology	7	PM24 Jan. 08	PM24 Jan. 08	7	CISEDIL
D7.5	Guidelines for site organisation and execution	7	PM24 Jan. 08	PM24 Jan. 08	7	CISEDIL

2.7.5 List of milestones

M7.1: 'Demonstration about the feasibility of the proposed technologies in real constructions, demonstration of the adequacy of the design, construction and execution' is reached 100%.

List of milestones for WP7, including due date and actual achievement date

Mil. no.	Milestone name	WP no.	Date due	Actual delivery date	Lead contractor
M7.1	Demonstration about the feasibility of the proposed technologies in real constructions, demonstration of the adequacy of the design, construction and execution	WP7	PM24 Jan. 08	PM24 Jan. 08	CISEDIL

3 CONSORTIUM MANAGEMENT

3.1 TASKS, ACHIEVEMENTS, PROBLEMS & SOLUTIONS

The management structure was set up during the first project year, The first step consisted in the creation of the reporting structure, and in the creation of the dedicated website: <http://diswall.dic.unipd.it/>. The website has been developed into two different areas: a private area in order to ensure the flow of information among partners and a public area for the dissemination of the results to specialized and general public. The Public Area allows getting a general idea of the project, with a general view on the main topics and aims of the project and an area dedicated to summaries of the main results from each WP. In the framework of the WP1 and the website, also a public data-base of existing reinforced masonry solutions, with their mechanical characteristics, to be used from both researchers and designers, was set up. The detailed objectives b) described in section §1.1 was thus fully achieved. During the second project year, the main management tasks mainly regarded the monitoring of the project status (under the technical and the economical points of view), the preparation of all the reports and the organization of the project meetings.

No major problems occurred during the two-project years. The physiological delays that can occur in this type of research were all absorbed during the project duration and corrective measures were taken only when necessary.

3.2 PROJECT MEETINGS & COMMUNICATION

The plenary project meetings were held as foreseen in the project. The Kick-off meeting was held in Italy, at the University of Padova, on 06/02/06. There a common methodology and criteria for the development of the project was agreed and a plan of activity for the first year was given, together with the first administrative information useful for the contractors. The Six Month Meeting was held in Germany, at the RWTH Aachen University, Institute of Building Materials Research (IBAC), on 29/06/06. At that meeting there was the presentation of the database and the website, and the presentation of the first prototypes materials with some experimental data. The Mid-Term meeting was held in Portugal, at the University of Minho, on 24-25/01/07. The preliminary version of exploitation and dissemination plans was presented. Furthermore, the developed construction techniques were presented, with practical demonstration of wall construction and testing. The Eighteen Month Meeting was held in Germany, at the Technische Universität München (TUM), on 02/07/07. At that meeting there was the presentation of the main experimental and numerical results achieved so far on the different reinforced masonry systems proposed. Also a demo of the So-Wall was shown. The Final Project Meeting was held at the University of Padua, on 10-11/01/08. There, the final results obtained on all the construction systems and all the Work Packages were presented. Furthermore, ideas on the future dissemination and exploitation of the results after the project end were given.

The timing of the meetings always marked the achievement of important milestones in the project. Communication between partners generally occurred via email.

3.3 CONTRACTORS & CONTRIBUTION

The contribution of each partner to the project was consistent with the original contribution planned in the Description of Work and in the Consortium Agreement. No changes in the partners' responsibilities were made. No change was made to the consortium nor was any contract amendment requested to change the work plan and/or the funding allocation. The overall budget foreseen to carry out the project was respected, with an overall expenditure during the two year duration equal to 1.338.281,43 € over the budgeted 1.341.758,42 €.

For this reason, the project coordinator on behalf of the entire consortium is requiring that the final payment, together with the pre-financings already received, will settle the amounts justified up to the maximum Community contribution for the DISWall project, equal to 997.500,00 €.

3.4 PROJECT STATUS

According to the activities reported in the previous sections, the project has been concluded reaching all the planned objectives, producing all the deliverables foreseen in the contract and reaching all the expected milestones, with no deviations from the project workprogramme.

3.5 LIST OF DELIVERABLES FOR WP1 – PROJECT MANAGEMENT

D1.1 'Public & Private website' is completed and is being regularly updated

D1.2 'Database of experimental results' is completed

D1.3 'Mid-term report' is completed

D1.4 'Final project report' is completed

List of deliverables for WP1, including due date and actual submission date.

Del. no. ¹	Deliverable name	WP no.	Date due	Actual delivery date	Estimated indicative person-months	Lead contractor
D1.1	Public & Private website	1	PM3 Apr. 06	PM3 Apr. 06	2	UNIPD
D1.2	Database of experimental results	1	PM6 July 06	PM6 July 06	5	UNIPD
D1.3	Mid-term report	1	PM12 Jan. 07	PM12 Jan. 07	5	UNIPD
D1.4	Final project report	1	PM24 Jan. 08	PM24 Jan. 08	5	UNIPD

3.6 LIST OF MILESTONES FOR WP1 - PROJECT MANAGEMENT

M1.1 'Open of public access to the database and website' is reached 100%.

M1.2 'Six monthly meetings (during project)' is reached 100%

List of milestones for WP1, including due date and actual achievement date

Mil. no.	Milestone name	WP no.	Date due	Actual delivery date	Lead contractor
M1.1	Open of public access to the database and website	WP1	PM6 July 06	PM6 July 06	UNIPD
M1.2	Six monthly meetings (during project)	WP1	Each six month	Each six month	UNIPD

4 OTHER ISSUES

The DISWall project was not subjected to requirements or recommendations concerning ethical issues.

The work between SMEs and RTD performers has been well balanced and has respected the work foreseen in the project. The SMEs have contributed to the project by sharing their own pre-existing know-how on the product and construction systems, by giving their availability in producing trial materials and carrying out further development of the materials in agreement with the RTD performers and by producing and building the specimens for the experimental testing. They also took care of some design phases/construction phases and details, as this is relevant for the marketing of their products. The RTD performers, on their side, have supported the phase of material and system development by means of intense theoretical studies, detailed design, experimental testing and data analysis and numerical simulations, with further development of design procedures and tools. It has to be highlighted that the studies carried out by the RTD performers could not be independently carried out by the SMEs, as such expertise required by this type of studies cannot be found in a SME. All the SMEs involved in the project arrived to the production of new products that can be applied into new construction systems, thus their benefit is evident, and are starting marketing actions for the developed systems. The Industrial Associations represented by ANDIL and ZIEGEL into the consortium have given their support mainly in the dissemination activities.

ANNEX – PLAN FOR USING AND DISSEMINATING THE KNOWLEDGE

A.1 EXPLOITABLE KNOWLEDGE AND ITS USE

A.1.1 Project results in brief

A wide number of deliverables (29) are foreseen in the Annex 1, Description of Work, of the Contract. However, the (actions) results of the project can be broadly grouped in the following categories:

1. Analysis of available experimental results. Type of results: data base of previous research (DBWall).
2. Analysis of available codes on masonry products. Type of results: list of requirement for masonry products.
3. Clay and concrete units. Type of result: new type of units.
4. Mortar and concrete. Type of result: on purpose developed mortar and self-compacting concrete.
5. Reinforcement. Type of result: developed type of reinforcement and fastenings.
6. Reinforced masonry. Type of result: newly developed reinforced masonry systems.
7. Destructive testing of masonry specimens. Type of result: improved testing techniques.
8. Non destructive testing of masonry specimens. Type of result: calibration of NDT for the use on modern masonry.
9. Numerical modelling of masonry specimens. Type of result: tools for optimizing the system design.
10. Parametric numerical assessment. Type of result: design charts.
11. Design of masonry walls. Type of result: Design guidelines and software code for wall design (SoWall).
12. Construction of real walls. Type of result: Guidelines for site organisation and execution.
13. Drawing up of guidelines. Type of result: Network of expertise on reinforced masonry.
14. NDT testing of real walls. Type of result: definition of NDE methods strategy for quality control.
15. Overall research activities. Type of results: exhibitions, publications, other dissemination activities.

These exploitable results of the project can be roughly divided into two main categories. The first is constituted by the exploitable knowledge, which means knowledge having a potential for industrial or commercial application in research activities or for developing new products or processes or services. The knowledge mainly arises from the theoretical studies carried out at the beginning of the project, on the previous experimental researches carried out and on the basic requirements for the products, from the theoretical and practical studies carried out during the testing and modelling phases (WP5) and, partially, from the parametrical assessment carried out for the design phase (WP6). The second category comprises the exploitable products and measures, which already constitute final objects, products or instructions that can be used by the end-users. These types of result mainly arise from the phase of the project related to the product (WP3) and construction system (WP4) development, through the validation given by the testing and modelling carried out in WP5 and the final validation carried out during the construction and testing of prototype building (WP7). Also the design phase (WP6) will provide a certain number of final products.

In the two following sections, the list of the project results, their potential applications and end-users, the main innovative features (technical/commercial success factors) and potential barriers are listed.

Exploitable Knowledge	Exploitable products or measures	Type	Sectors of application	Timetable commercial use	Patents or other IPR protection	Owner & Partner(s) involved
1. Analysis of available experimental results	Data base of experimental results (DBWall)	Database	1. Consultancy firms 2. Unit, mortar, reinforcement industry 3. Research	Downloadable from the project website (free tool)	Free	All the project partners
2. Product requirements	List of requirement for masonry products	Report	1. Research 2. Standardization 3. Unit, mortar, reinforcement industry	Public deliverable available from July 2006	Free	All the project partners
3-4-5. Improved material properties	1. Horizont. perf. clay units	Product	1. Unit, mortar, reinforcement industry 2. Construction	2008	No patents are planned at the moment	ALAN
	2. 'C' shaped clay units			2007		CISEDIL
	3. Large hollow concrete unit			2008		C&A
	4. Large hollow clay unit			2009		UNIPOR
	5. Mortar			2008		TASSULLO
	6. Special reinforcement			2008		BEKAERT
6. New Reinforced masonry systems	1. Horizontally perforated clay units masonry	Product	1. Construction 2. Unit, mortar, reinforcement industry	2009	No patents are planned at the moment	ALAN; TASSULLO; BEKAERT
	2. 'C' shaped clay units mas.			2008		CISEDIL; TASSULLO
	3. Large hollow con. unit mas.			2010		UNIPOR; BEKAERT
	4. Large hollow clay unit mas.			2009		C&A; BEKAERT
7. Destructive testing of masonry specimens	1. Improved in-plane testing	Process /Technology	1. Research 2. Standardization	Public deliverable available from Oct. 2006	Free	All the project partners
	2. Improved outofplane test.					
	3. 'L' SCC test					
8. Non destructive testing of masonry specimens	1. GPR	Process /Technology	1. Research 2. Service industry 3. Construction 4. Sensor industry	Public deliverable available from Oct. 2006	Free	All the project partners
	2. Covermeter					
	3. UPV					
	4. Sonic tests					
	5. Impact echo					
	6. Thermography					
	7. Dynamic tests					
9. Numerical modelling of masonry specimens.	1. Improved FEM models	Process /Technology	1. Research 2. Standardization 3. Consultancy firms 4. Unit, mortar, reinforcement industry	2008	No patents are planned at the moment	All the project partners
	2. Improved analytical models					
10. Parametric numerical assessment	Design charts.	Service/ Process	1. Consultancy firms 2. Standardization 3. Research	2008	No patents are planned at the moment	All the project partners

Exploitable Knowledge	Exploitable products or measures	Type	Sectors of application	Timetable commercial use	Patents or other IPR protection	Owner & Partner(s) involved
11. Design of masonry walls	1. Design guidelines	Guidelines	1. Consultancy firms 2. Construction	Public deliverable avail. from Jan. 2008	Free No patents are planned at the moment	All the project partners
	2. Software for design (SoWall)	Software		Public avail. from Jan. 2008		
12. Construction of real walls	Construction guidelines	Guidelines	1. Construction 2. Consultancy firms	Public deliverable avail. from Jan. 2008	Free	All the project partners
13. Drawing up of guidelines	Network of expertise on reinforced mas.	Databases	1. Construction 2. Consultancy firms 3. Research	Public avail. from Jan. 2008	Free	All the project partners
14. NDT testing of real walls	Definition of NDE methods strategy for quality control	Service/Process	1. Service industry 2. Construction 3. Sensor industry 4. Standardization	2008	Free	All the project partners
15. Overall research activity	Various dissemination activities	Exhibitions, publications ...	1. Research 2. Standardization 3. Consultancy firms 4. Construction	2007/2008	Free	All the project partners

A.1.2 Exploitable knowledge

1. The data base of previous experimental research (DBWall, D1.2) consist in a search engine that allows getting information on past researches on reinforced masonry walls that have been selected and introduced into the same data-base. The advance search option allows differentiating the data collected into the data base on the bases of detailed parameters. The result is a list of record, corresponding to the single masonry specimens tested into different experimental researches that meet the search criteria, with the main mechanical parameters associated with the specimen itself. This report allows processing homogeneous data in order to obtain statistical information, elaborate mathematical formulation, etc. The DBWall thus constitutes a powerful exploitable knowledge of the project, and is a very interesting tool for the advancement of the researches and for the standardization. The scientific relevance of this tool is evident as no data-base of this kind has been elaborated before.

2. The list of requirement for masonry products (contained in D3.1) consists in a state of the art on the properties and requirements on the masonry components. This list constitutes an exploitable knowledge of the project because it helps the researchers in the further development of the materials. It is also useful because it highlights the needs for standardization (some properties do not have a reference standard describing their testing procedure), and the lack on minimum requirements for some important properties. Furthermore, it gives a complete set of information about different materials (units, mortar, concrete,

reinforcement), so it is possible for the developers of reinforced masonry systems to understand the direction to be given to the product development. The relevance of this list is evident as in literature only partial lists can be found, but such a systematic work has not been done before.

7. The literature research and the improvement of the laboratory testing techniques has a relevance for the research world, first because it constitutes a complete state of art on in-plane and out-of-plane testing procedures, second because it highlights the positive and negative aspects of different procedures, and thus allows carrying out further improvement on them. Most of the testing procedures proposed in the DISWall project are not harmonized neither standardized, even if they are used in literature. It is of great relevance to define standardized testing procedures, as on the contrary it is not possible to compare the test results of different experimental works. The exploitation of this knowledge into the standardization process is evident.

8. The calibration of NDT for the use on modern masonry is another useful knowledge. On one hand this calibration constitutes the base for further research, as the application of NDT methods to historic masonry is a relatively recent field of investigation, but the application to modern masonry is almost a completely new field of research. The exploitation of this knowledge into the standardization process will come, in fact, after further calibrations and research, needed to understand more deeply the potentiality and the limitations of the tested techniques. On the other hand, this knowledge, tested in practice on the real building and converted into best practice for the NDT application to modern masonry, is also exploitable by the service industry (companies for inspection), the construction industry (interested in quality assessment and certification for the buildings), the sensor industry (new market is open by the development of a new area of application for their industry).

9-10. The numerical modelling of masonry specimens gives as a result the definition of optimal modelling strategies for reinforced masonry walls and an assessed way for defining the critical mechanical parameters of the developed systems. It has found out the limitations of the proposed construction technologies and has assisted, and will assist in the future for further improvements, the tasks of optimising the materials, products, and the system design. Furthermore, by means of parametric studies, the task of optimizing the design formulations and give design charts has been achieved. This knowledge is thus mainly exploitable by the researchers for studies and standardization but also, transversally, by the producers for the purpose of optimizing the design procedures. The novelty of the numerical approach used in the project stands also in the complementary use of different modelling approach and in the simultaneous definition of modelling procedures for different types of reinforced masonry at once, which gives a broad view of the problem.

15. Finally, the different dissemination activities carried out at different level, such as the participation into exhibitions, the organization of workshops, the publications of technical and scientific papers, etc., constitute both an exploitable knowledge and product of the research. These actions, in fact, can be seen as pillars on which further research, based on the work done in the project, will be based. This research can be carried out inside the consortium but can also intersect the activity of other researchers and research groups, reaching a broader societal and economical impact. Publications and communication inside the scientific community is the solely way to enrich the project results with other people experience and to make the scientific community aware of the project results to help them identifying future research lines and projects.

A.1.3 Exploitable products or measures

1. The data base of previous experimental research (DBWall) can be considered also a product of the research, exploitable by the involved SMEs and usable by professionals (architects, engineers, etc). Its results, in fact, can be used to understand the reinforced masonry potentialities (and in this sense the SMEs are interested in delivering it as demonstration tool to the professionals) and help the professionals (which are its end-users) with the calculations. This tool can be freely downloaded from the project web-site and has a significant value as no data-base of this kind has been elaborated before. The main problem consists in the data-base maintenance and updating after the project end.

3-4-5. The new type of units, mortar and self-compacting concrete, reinforcement and fastenings, are mainly intended for the reinforced masonry walls developed in the project. However, they can be even used separately for any other type of masonry construction (the units and the mortar) or general construction (the concrete and the reinforcement) where their properties result to be still adequate for the application. The end-users of this result will be the contractors and building companies involved in the construction of reinforced masonry and other (mainly masonry) constructions. Their main innovative benefits rely in the fact that they have been developed for the application into reinforced masonry systems, so their properties have been purposely improved, as described more in detail on WP3 and WP4. The cost of the different developed products (units, mortar self-compacting concrete, reinforcement) is the same of parallel products that already exist on the market, but their properties are improved for the application on reinforced masonry (better constructability and reduction of the wall maintenance with all the developed units, improved hydraulic pressure resistance for the units for concrete infill, better thermal insulation for the units with horizontal holes, better workability for the mortar, improved slump properties for the self-compacting concrete, improved constructability with the Murfor and the special large hollow clay units developed reinforcement, etc.). Therefore, no potential barriers are foreseen.

6. The newly developed reinforced masonry systems consist of innovative construction technologies developed for reinforced brick masonry walls. These technologies are mainly intended for construction of medium to large span infill walls (non-load-bearing) and structural masonry for small and medium height buildings (up to three storeys), such as residential buildings, and for single-story tall walls, such as those found in industrial buildings, gymnasium, etc. Therefore, it is believed that the entire possibilities for masonry buildings construction has been investigated, giving new opportunities to the construction sectors. The end-users of this result are, again, the building companies involved in the construction of reinforced masonry constructions. The main innovation of the proposed construction technologies does not lie in the technology itself (i.e. the reinforced masonry walls, existing since the end of the Seventies-beginning of the Eighties) rather in the improvement-new solutions proposed, described in detail in WP3 and WP4, aimed at improving the mechanical behaviour of the system and at increasing its constructability and economic competitiveness. The main obstacle possibly preventing the use of these technologies is constituted by the fact that the construction world is highly conservative and the cost is higher if compared to unreinforced masonry. However, this problem is overcome by the fact that the new seismic standards make it almost impossible to build with unreinforced masonry, so to avoid the loss of a traditional material (masonry), an extra cost is unavoidable. Furthermore, for most of the systems the cost revealed to be lower than in the case of framed

buildings with infill walls. Therefore, the proposed systems present improved properties but still remain competitive in the construction sector market.

10-11. The design guidelines consist of a set of sound, yet simple, structural design guidelines for reinforced masonry walls. These rules are implemented in design charts and in a simple software code for assisting the design and assessment of the walls (SoWall). The rules could be also incorporated into structural codes, mainly Eurocode 6 and Eurocode 8 and their corresponding National Application Documents. The guidelines, charts and software can be used for day-to-day design of reinforced masonry walls. The end-users of these results are thus consultancy firms involved in the design and structural design of buildings. Presently there is a certain complexity in the structural design criteria for reinforced masonry walls, because they are not clearly stated for certain types of masonry (large hollow clay unit, for example) or for certain systems (confined masonry). Furthermore, there is often a discrepancy between European and National standards, and very often even a lack of regulations into the national standards. The design is dominated by the use of complicated simulation tools, and there are not simple assessment tools, such as those downloadable for reinforced concrete sections, available for reinforced masonry walls. The main obstacle possibly preventing the use of these results is the lack of official regulations, till they won't be developed in each country and at a European level. However these tools are of great relevance for the success of the developed systems, as it is of crucial importance, in the construction sector, to supply a new construction system together with the basic rules for its application and a tool for its calculation.

12. The guidelines for site organisation and execution are of practical relevance for the building companies involved in the construction of reinforced masonry constructions, which are, actually, the main end-users of this result. In the market there are a number of reinforced masonry systems, but generally the description on how the arrangement of the same should be made is remitted to the sale marketing operator, who generally is not prepared under the technical point of view. This is also one reason for reinforced masonry to have a very low market share in the construction sector. The basic role of a handbook or guidelines or simple instructions on site organisation and execution is clear. A search has been made but it seems that, in literature, such a comprehensive document, based only on reinforced masonry but describing more that one single reinforced masonry system, did not exist. It will help the end-users not only during the construction phase, but also in the preliminary and design phase, to select the system that is more appropriate for the specific application and the environment in which the building has to be built.

13. In the framework of the guidelines for site organisation and execution, a list of contact details listing all the main organization, in different countries around the world, which are in charge of developing and promoting the use of general and reinforced masonry (non-profit organizations, research organization, industrial associations, etc.) has been created. This network of expertise on reinforced masonry is deemed to be very useful for the end-users such as the designers (architects and engineers) and the contractors, as if they need further information on reinforced masonry systems, materials, standards, etc. in their own country, they can find a contact organization able to provide them with the relevant information. Such a list will be also published in the project web-site, in order to be more easily accessible and exploitable.

14. The definition of NDE methods strategy for quality control is a measure which cannot be yet defined a product, as final guidelines on the application of NDT testing methods on modern masonry buildings will be developed only after carrying out further research. However the strategy for quality control that has been outlined after the laboratory calibration of the NDT methods and the application to real case studies, where

limitations and possibilities of different NDT methods have been highlighted, can be already applied, as best practice, in the case of disputes and other cases where it is necessary to obtain information on the existing structures without creating any damage to the building. The users of this product are thus the service industry (companies for inspection), the construction industry (interested in quality assessment of the buildings) and the sensor industry (new market is open by the development of a new area of application for their industry). Currently, guidelines for the application of NDT methods to masonry buildings have been developed only for historic masonry. Modern masonry is characterized by the use of different materials (perforated or hollow units, reinforcement, etc), thus the application of the test methods, which are sensitive to this type of factors, is different. It is thus clear that the definition of a strategy for the application of the non destructive methods to the modern masonry is needed. The potential barriers are constituted by the very scarce knowledge in this sector, which could delay the complete definition of the techniques application after the end of the project. However, the fact that the industry propose, together with new construction systems, also the tools for the assessment, is a novelty and can increase the confidence in the new systems.

15. Finally, the different dissemination activities carried out at different level, such as the participation into exhibitions, the organization of workshops, the publications of technical and scientific papers, etc., can be also considered as an exploitable product of the research. Some of these actions, such as workshop for practitioners, publication on national technical reviews, participation at construction fairs, etc., in fact, are mainly addressed to the end users (architects, engineers, contractors) of the developed systems. Furthermore, a dissemination activity such as the academic training is also addressed to the future end-users. Therefore, these actions can be seen as products, because they give practical and useful information (mainly on construction and design aspects), which can be directly used by the end-users to use in practice the developed systems.

A.2 DISSEMINATION OF KNOWLEDGE

The dissemination activities, planned and carried out, are monitored by means of two structures:

- “Monitoring of planned dissemination”, for monitoring planned activities;
- “Reporting of completed actions”, for reporting those already completed.

In the following, these two tables are presented, the first for the activities to be carried out after the project end, the second for the activities actually carried out in the two years of the project. Further detail on the dissemination can be found in D2.4a ‘Dissemination final report’.



“Planned dissemination activities – Period after January 2008”

Planned date	TYPE OF ACTION	DESCRIPTION	TITLE	Information	RESPONSIBLE PARTNER	MAIN TARGET GROUP	OTHER TARGET GROUP	DISSEMINATION LEVEL		Countries addressed	NOTES	STATUS
								Size of audience	Level			
January 2008	Workshops and seminars	Presentation of reinforced masonry systems of DISWall project		Workshop organized by the Body of Professionals of Reggio Emilia	UNIPD	Architects; Engineers; Professional bodies	Contractors, Enterprises	100	Regional	Italy		Foreseen
January 2008	Prints	report in annual book	DISWALL – Developing Innovative Systems for reinforced masonry Walls	ibac-Mitteilungen 2007	RWTH	Scientists and researchers	Various	800	International	Europe		Foreseen
January 2008	Exhibitions and fairs	Presentation at the KLIMAHOUSE 07 fair	International exhibition for energy efficiency and sustainable building		TASSULLO	Architects; Engineers; Professional bodies	Contractors, Enterprises		International	Europe		Foreseen
January 2008	Training and Academic courses	Presentation of the construction method and the research results	"Neue Entwicklungen im Mauerwerksbau"		RWTH	University and training organizations		50	National	Germany		Foreseen
January 2008	Conferences and meetings	Comments about reinforced masonry systems of DISWall project	Dutch masonry council at the TU of Eindhoven		BEKAERT	Industry; Manufacturers; Industrial Associations	University and training organizations		International	Europe		Foreseen
January 2008	Standardization committees	Presentation of the DISWall project and its main results	UNI Commissione “Ingegneria strutturale”- SC 6 "Strutture di muratura"	Presentation of the project to the UNI SC6 Standardization Committee	ANDIL	Industry; Manufacturers; Industrial Associations	Scientists and researchers		National	Italy		Foreseen
January 2008	Standardization committees	Presentation of the DISWall project and its main results	TBE Joint Brick & Block PGs (TC 125, TC 250/SC 6, TC 250/SC 8), 31/01/2008 Brussels	Presentation of the project to the TBECCommittee	ANDIL	Industry; Manufacturers; Industrial Associations	Scientists and researchers		International	Europe		Foreseen
February 2008	Others	Graduation thesis	Out-of-plane tests on reinforced masonry	Discussion of the Graduation Thesis at the University of Padua	UNIPD	University and training organizations	Various	50	Regional	Italy		Foreseen
February 2008	Conferences and meetings	Presentation of in-plane test results	14th International Brick and Block Masonry Conference	Main international 4year conference on masonry matters	UNIPD	Scientists and researchers	Industry; Manufacturers; Industrial Associations		International	World		Foreseen
February 2008	Conferences and meetings	Presentation of DISWALL results		technical committee of the German Clay masonry producers	ZIEGEL	Industry; Manufacturers; Industrial Associations		15	National	Germany		Foreseen
February 2008	Conferences and meetings	Presentation of reinforced masonry systems	14th International Brick and Block Masonry Conference	Main international 4year conference on masonry matters	UMINHO	Scientists and researchers	Architects; Engineers; Professional bodies		International	World		Foreseen
February 2008	Conferences and meetings	Presentation of the test-results and the proposed design model	14th International Brick and Block Masonry Conference	Main international 4year conference on masonry matters	TUM	Scientists and researchers	Architects; Engineers; Professional bodies		International	World		Foreseen
February 2008	Conferences and meetings	Presentation of reinforced masonry systems	Buyers & Sellers Meeting		ALAN	Industry; Manufacturers; Industrial Associations	Contractors, Enterprises		National	Italy		Foreseen



February 2008	Conferences and meetings	Presentation of DISWall activities by CISEDIL and UNIPD	Consorzio Poroton Italia Assembly		CISEDIL	Industry; Manufacturers; Industrial Associations		25	National	Italy	Info video and about results project	Foreseen
February 2008	Workshops and seminars	Presentation of problems with construction and maintenance with the new codes	Problematiche di conservazione e formulazione dei piani manutentivi alla luce dell'attuale normativa	Workshop in Vicenza	TASSULLO	Architects; Engineers; Professional bodies	Contractors, Enterprises	250	Regional	Italy		Foreseen
March 2008	Exhibitions and fairs	Presentation at the MOLDCONSTRUCT fair	XIII International Specialized Exhibition of architecture, technologies, equipment, tools, installations and materials for construction		TASSULLO	Contractors, Enterprises	General public		International	Moldova		Foreseen
March 2008	Workshops and seminars	Presentation of reinforced masonry systems and of DISWall project		Workshop organized by the clay unit dealers	UNIPD	Industry; Manufacturers; Industrial Associations			National	Italy		Foreseen
March 2008	Publication on technical and/or peer reviews	Presentation of DISWALL results	Reports of Arge Mauerziegel	Publication	ZIEGEL	Architects; Engineers; Professional bodies	Scientists and researchers	1000	National	Germany		Foreseen
April 2008	Exhibitions and fairs	Presentation at the CONSTRUCT-EXPO fair	Construct Expo - the international exhibition of architecture, technologies, equipment, installation, tools, fitting and materials for construction.		TASSULLO	Contractors, Enterprises	Architects; Engineers; Professional bodies		International	Romania		Foreseen
April 2008	Others	Graduation thesis	Dynamic Analysis of the in-plane behaviour of reinforced masonry walls	Discussion of the Graduation Thesis at the University of Padua	UNIPD	University and training organizations	Various	50	Regional	Italy		Foreseen
April 2008	Others	Graduation thesis	Dynamic Analysis of the out-of-plane behaviour of reinforced masonry walls	Discussion of the Graduation Thesis at the University of Padua	UNIPD	University and training organizations	Various	50	Regional	Italy		Foreseen
April 2008	Conferences and meetings	Presentation of the results of in-plane tests	CCC2008	International conference on Civil Engineering structures and construction	UMINHO	Scientists and researchers			International	World		Foreseen
April 2008	Prints	Presentation of the construction method and the research results	Pubblication on "Alveolater News n° 29"	The Bulletin of ALVEOLATER	ALAN	Architects; Engineers; Professional bodies	Industry; Manufacturers; Industrial associations	29000	National	Italy	Paper	Foreseen
April 2008	Web site	Presentation of the reinforced masonry system developed in Italy with the clay units by ALAN	http://www.alanmetauro.com	ALAN website	ALAN	Various			National	Italy		Foreseen
April 2008	Web site	Presentation of DISWALL results	http://www.alveolater.com	ALVEOLATER website	ALAN	Various			National	Italy		Foreseen
April 2008	Web site	Presentation of the reinforced masonry system developed	http://www.muraturaarmata.it	Muratura armata website	ALAN	Various			National	Italy		Foreseen
April 2008	Others	Presentation of the reinforced masonry system developed	Newsletter		BEKAERT	Architects; Engineers; Professional bodies	Contractors, Enterprises	20000	National	Italy		Foreseen




May 2008	Conferences and meetings	Presentation of the reinforced masonry system developed	Masonry conference in Athens		BEKAERT	Scientists and researchers	Architects; Engineers; Professional bodies		National	Greece		Foreseen
MAY 2008	Web site	Presentation of the USE OF MURFOR reinforced masonry system developed	WWW.BEKAERT.COM/BUILDING		BEKAERT	Various			National	Belgium		Foreseen
MAY 2008	Others	Presentation of the reinforced masonry system developed	NEWSLETTER		BEKAERT	Various			International	Europe		Foreseen
May 2008	Conferences and meetings	Presentation of the results of out-of-plane tests	2nd Canadian Conference on Effective Design of Structures	International Conference of the Centre for Effective Design of Structure	UNIPD	Scientists and researchers			International	World		Foreseen
May 2008	Conferences and meetings	Presentation of the results of non destructive tests	2nd Canadian Conference on Effective Design of Structures	International Conference of the Centre for Effective Design of Structure	UNIPD	Scientists and researchers			International	World		Foreseen
May-June 2008	Training and Academic courses	Presentation of reinforced masonry systems and of DISWall project	Structural Analysis 3' course, Fac. of Engineering, Padua	Academic lectures	UNIPD	University and training organizations		100	Regional	Italy		Foreseen
June 2008	Workshops and seminars	Prints of the project	L'Architettura di Gio Ponti e il suo tempo		TASSULLO	Architects; Engineers; Professional bodies	Contractors, Enterprises	200	Regional	Italy		Foreseen
June 2008	Conferences and meetings	Presentation of the reinforced masonry system developed with the Italian clay units (by ALAN and CISEDIL)	ANDIL General Assembly	Annual conference of the Italian Clay Industry	ANDIL	Industry; Manufacturers; Industrial Associations	Various	200	National	Italy		Foreseen
June 2008	Training and Academic courses	Lecture University of Applied Sciences Cologne	Masonry Structures in German Seismic Regions	Academic lectures	ZIEGEL	University and training organizations		30	Regional	Germany		Foreseen
June 2008	Prints	Presentation of the developed system	DISWALL – Developing Innovative Systems for reinforced masonry Walls	newsletter	RWTH	Scientists and researchers	Various	200	National	Germany		Foreseen
August 2008	Prints	Presentation of the construction method and the research results	Publication "Mauerwerk"	Technical magazine	RWTH	Architects; Engineers; Professional bodies	Scientists and researchers	1000	National	Germany		Foreseen
September2008	Conferences and meetings	Presentation of the results of non destructive tests	International RILEM Conference On site assessment of concrete, masonry and timber structures	RILEM conference of NDTs and testing methods	UNIPD	Scientists and researchers	Industry; Manufacturers; Industrial Associations		International	World		Foreseen
September2008	Conferences and meetings	Presentation of DISWALL results	General Assembly of D.A.CH.	Association of German, Austrian and Swiss Clay Producers	ZIEGEL	Industry; Manufacturers; Industrial associations		15	International	Europe		Foreseen
September2008	Other	Presentation of DISWALL results	MAILING ACTIONS .		BEKAERT	Industry; Manufacturers; Industrial associations			International	Europe		Foreseen



October 2008	Conferences and meetings	Presentation of the results of out-of-plane tests analysis	14th World Conference on Earthquake engineering	4year Conference of the International Association for Earthquake Engineering (IAEE)	UNIPD	Scientists and researchers			International	World		Foreseen
October 2008	Conferences and meetings	Presentation of the results of in-plane test analysis	14th World Conference on Earthquake engineering	4year Conference of the International Association for Earthquake Engineering (IAEE)	UNIPD	Scientists and researchers			International	World		Foreseen
October 2008	Exhibitions and fairs	Presentation of the reinforced masonry system developed with the Italian clay units	SAIE08	International exhibition of building industrialisation, Bologna	ANDIL	Industry; Manufacturers; Industrial associations	General public	30000	International	Europe		Foreseen
October 2008	Prints	Presentation of the test-results, the design process and the application in practice	Bewehrtes Vefüllziegelmauerwerk – Verhalten unter kombinierter N-M-V-Beanspruchung	das Mauerwerk	TUM	Architects; Engineers; Professional bodies	Industry; Manufacturers; Industrial Associations	500	National	Germany		Foreseen
November 2008	Conferences and meetings	Presentation of the results of Diswall	ISSM08	International Seminar on Structural Masonry	UMINHO	Scientists and researchers			International	World		Foreseen
November 2008	Conferences and meetings	Presentation of innovative reinforced masonry systems and of DISWall project results	International masonry conference		BEKAERT	Scientists and researchers	Architects; Engineers; Professional bodies		International	Europe		Foreseen
November 2008	Conferences and meetings	Presentation of innovative reinforced masonry systems	ISSM 2008 – ISTANBUL	International seminar	BEKAERT	Architects; Engineers; Professional bodies			International	World		Foreseen
December 2008	Training and Academic courses	Presentation of reinforced masonry systems and of DISWall project	Structural Analysis 2', Fac. of Engineering, Padua	Academic lectures	UNIPD	University and training organizations		100	Regional	Italy		Foreseen
December 2008	Prints	Presentation of the construction method and the research results	Publication "ZI Ziegelindustrie International"	Paper	RWTH	Industry; Manufacturers; Industrial associations	Architects; Engineers; Professional bodies	5000	International	World		Foreseen
2008	Press events	Presentation of reinforced masonry systems and results of DISWall project	"ANDIL NOTIZIE"	The monthly Bulletin of ANDIL	ANDIL	Industry; Manufacturers; Industrial associations		200	National	Italy	Dissemination document: <u>paper</u>	Foreseen
2008	Publication on technical and/or peer reviews	Presentation of reinforced masonry systems and results of DISWall project	Publications "L'industria dei laterizi" (Clay Bricks' Industry)	A technical magazine aimed to disseminate data and information related to the Italian Industry. It approaches the energy, environment, production and product, Research, and technical standards.	ANDIL	Industry; Manufacturers; Industrial associations	Scientists and researchers	5000	International	Europe	Dissemination document: <u>paper</u>	Foreseen

2008	Publication on technical and/or peer reviews	Presentation of reinforced masonry systems and results of DISWall project	Publications "Costruire in Laterizio" (Building with Clay Products)	A bimonthly magazine on the performances, the rules of art, the technology innovation, and the protagonists of clay bricks Architecture.	ANDIL	Architects; Engineers; Professional bodies	Scientists and researchers	25000	National	Italy	Dissemination document: <u>paper</u>	Foreseen
2008	Web site	Presentation of results of DISWall project	http://www.laterizio.it	Andil web site	ANDIL	Various			National	Italy	NEWS	Foreseen
2008	Training and Academic courses	Presentation of the reinforced masonry system developed with the Italian clay units (by ALAN and CISEDIL)	ANDIL-ANCE Seminars, University Seminars and Designer Courses	University-Industry collaboration	ANDIL	Architects; Engineers; Professional bodies	University and training organizations	200	National	Italy		Foreseen
2008	Prints	Presentation of the reinforced masonry system developed with the Italian clay units (by CISEDIL)	News on "Muratureoggi"	The Bulletin of POROTON	CISEDIL	Architects; Engineers; Professional bodies	Contractors, Enterprises	12000	National	Italy		Foreseen
2008	Workshops and seminars	Presentation of the reinforced masonry system developed with the Italian clay units		University-Industry collaboration	BEKAERT	Architects; Engineers; Professional bodies	Industry; Manufacturers; Industrial Associations		National	Italy		Foreseen
2008	Workshops and seminars	Presentation of reinforced masonry systems and of DISWall project		2 o 3 Regional workshops	BEKAERT	Architects; Engineers; Professional bodies	Industry; Manufacturers; Industrial Associations	100	Regional	Italy		Foreseen
2008	Publication on technical and/or peer reviews	Presentation of the construction method and the research results		Article will be published in the magazine of the greek civil engineering	BEKAERT	Architects; Engineers; Professional bodies			National	Greece		Foreseen
2008	Others	Presentation of reinforced masonry systems and of DISWall project		Article about dealing with building and construction (to sent to turkey, rou, ex yugo, middle east,)	BEKAERT	Industry; Manufacturers; Industrial Associations			International	Europe		Foreseen




“Completed dissemination activities - Period January 2006 – January 2008”

Part. N°	PARTNER short name	DATE & PLACE	TYPE OF ACTION	TITLE	ORGANIZERS/ SPONSORS	MAIN TARGET GROUPS	OTHER TARGET GROUP	DISSEMINATION LEVEL		Countries addressed	NOTES
								N° of copies/ participants	Level		
1		March 2006	Web site	http://diswall.dic.unipd.it		Various		10000	International	World	
		April 2006	Others	Comportamento meccanico di sistemi costruttivi in muratura armata: impostazione di un data-base ed analisi di risultati sperimentali	Faculty of Engineering - University of Padua	University and training organizations	Various	50	Regional	Italy	Discussion and publication of Graduation thesis
		May 2006, Pavia	Workshops and Seminars	Metodi sperimentali per la valutazione delle prestazioni. Nuove tipologie murarie', Progettazione antisismica degli edifici in muratura, Pavia 5-6 May 2006	EUCENTRE - University of Pavia	Architects; Engineers; Professional bodies	Contractors, Enterprises	50	National	Italy	Lecture in the framework of a seminar
		June 2006, Padova	Training and Academic courses	Structural Analysis 3', Fac. of Engineering, Padua	Faculty of Engineering - University of Padua	University and training organizations		100	Regional	Italy	
		14-15 September 2006, Bruxel	Standardization committees	Subcommittee CEN/TC 250/SC6 “Masonry Structures”; CEN/TC 125 “Masonry”	CEN/TC 250/SC6; CEN/TC 125	Industry; Manufacturers; Industrial associations	Scientists and researchers	25	International	Europe	
		30 Oct-1 Nov 2006, London	Prints		British Masonry Society	Scientists and researchers	Industry; Manufacturers; Industrial associations	130	International	Europe	Brochure introducing DISWall Project and its main aspects of interest.
		30 Oct-1 Nov 2006, London	Conferences and meetings	Developing innovative systems for reinforced masonry systems', Proc. 7th International Masonry Conference, London, 30 Oct-1 Nov 2006	British Masonry Society	Scientists and researchers	Industry; Manufacturers; Industrial associations	150	International	Europe	Publication and presentation of paper
		December 2006	Training and Academic courses	Structural Analysis 2', Fac. of Engineering, Padua	Faculty of Engineering - University of Padua	University and training organizations		100	Regional	Italy	
		15 Dec. 2006	Workshops and seminars	TASSULLO seminars	TASSULLO	Architects; Engineers; Professional bodies	Contractors, Enterprises	200	Regional	Italy	
		June 2007	Training and Academic courses	Structural Analysis 3', Fac. of Engineering, Padua	Faculty of Engineering - University of Padua	University and training organizations		100	Regional	Italy	



		3-6 June 2007	Conferences and meetings	10th North American Masonry Conference	North American Masonry Society	Scientists and researchers	Industry; Manufacturers; Industrial Associations	150	International	World	
		28 Sept. 2007	Workshops and seminars	La Vendita dei Laterizi: come migliorare le performance commerciali	ANDIL	Industry; Manufacturers; Industrial Associations		30	National	Italy	
		1-2 Oct. 2007	Conferences and meetings	CIB COMMISSION W023 - Wall Structures, 44th Meeting	CIB	Scientists and researchers	Industry; Manufacturers; Industrial Associations	20	International	World	
		30 Oct. 2007	Workshops and seminars	Le Nuove Norme Tecniche per le Costruzioni	Body of Building Surveyor of Parma	Architects; Engineers; Professional bodies		100	National	Italy	
		24 Oct. 2007	Others	Sperimentazione e modellazione del comportamento meccanico di pannelli di muratura portante in laterizio armato	Faculty of Engineering - University of Padua	University and training organizations	Various	50	Regional	Italy	Discussion and publication of Graduation thesis
		December 2007	Training and Academic courses	Structural Analysis 2', Fac. of Engineering, Padua	Faculty of Engineering - University of Padua	University and training organizations		100	Regional	Italy	
2		May 2006	Press events	Alveolater news n.25	Consorzio Alveolater	Architects; Engineers; Professional bodies	Industry; Manufacturers; Industrial associations	27000	National	Italy	Muratura Armata. DISWall: un progetto europeo (Reinforced Masonry Diswall: an European Research)
		April 2007	Workshops and seminars	CALCOLO MURATURE semplici ed armate	ALAN - Peredil workshop in Terni	Architects; Engineers; Professional bodies	Contractors, Enterprises	50	Regional	Italy	
		06 March 07	Workshops and seminars	CALCOLO MURATURE semplici ed armate	ALAN workshop in Grosseto	Architects; Engineers; Professional bodies	Contractors, Enterprises	200	Regional	Italy	
		20 April 07	Workshops and seminars	Le murature in laterizio, prestazioni e certificazioni	ALAN - Peredil workshop in Terni	Contractors, Enterprises	Architects; Engineers; Professional bodies	100	Regional	Italy	




		15 November 2007	Workshops and seminars	Le murature in laterizio, prestazioni e certificazioni	ALAN - Ceredil in workshop Macerata	Contractors, Enterprises	Architects; Engineers; Professional bodies	100	Regional	Italy	
3		14 December 2007	Conferences and meetings	Executive Committee of Consorzio Poroton Italia	Consorzio Poroton	Industry; Manufacturers; Industrial Associations		10	National	Italy	Info and video about results project carried out by CISEDIL and UNIPD
4		23-27 October 2007	Exhibitions and fairs	CONCRETA	Porto	Architects; Engineers; Professional bodies	Contractors, Enterprises	5000	National	Portugal	
5		23 November - 13 December 2006	Exhibitions and fairs	"IL COLORE del sacro, dell'anima e della tecnologia"	Tassullo	General public		20000	National	Italy	Exhibition site: new Research Center of Tassullo (Trento - Italy)
		June 2007	Web site	DISWALL	Tassullo	Contractors, Enterprises	Architects; Engineers; Professional bodies	10000	National	Italy	Presentation on the company website
		5 October 2007	Workshops and seminars	Il miglioramento sismico negli edifici vincolati	Tassullo	Architects; Engineers; Professional bodies	Contractors, Enterprises	350	Regional	Italy	Given information on the new systems
		6 December 2007	Workshops and seminars	L'Architettura di Gio Ponti e il suo tempo	Tassullo	Architects; Engineers; Professional bodies	Contractors, Enterprises	200	Regional	Italy	Given information on the new systems
6		5 April 2006	Conferences and meetings	technical board	UNIPOR	Industry; Manufacturers; Industrial Associations		15	National	Germany	Given information on the DISWALL Projekt
		11 April 2006	Conferences and meetings	non-executive board	UNIPOR	Industry; Manufacturers; Industrial Associations		10	National	Germany	Given information on the DISWALL Projekt





		13 October 2006	Conferences and meetings	shareholder meeting	UNIPOR	Industry; Manufacturers; Industrial Associations		50	National	Germany	Given information on the DISWALL Projekt
		5 December 2006	Conferences and meetings	technical board	UNIPOR	Industry; Manufacturers; Industrial Associations		15	National	Germany	Given information on the DISWALL Projekt
		16 January 2007	Workshops and seminars	Bewehrter Schalungsziegel		Architects; Engineers; Professional bodies	Contractors, Enterprises	100	Regional	Germany	Given information on the new systems
		9 February 2007	Workshops and seminars	Bewehrter Schalungsziegel		Architects; Engineers; Professional bodies	Contractors, Enterprises	50	Regional	Germany	Given information on the new systems
		8 March 2007	Conferences and meetings	technical board	UNIPOR	Industry; Manufacturers; Industrial Associations		15	National	Germany	Given information on the new systems
		5 October 2007	Conferences and meetings	shareholder meeting	UNIPOR	Industry; Manufacturers; Industrial Associations		50	National	Germany	Given information on the new systems
		25 October 2007	Conferences and meetings	technical board	UNIPOR	Industry; Manufacturers; Industrial Associations		15	National	Germany	Given information on the new systems
7		March 2006	Web site	http://www.laterizio.it	ANDIL Assolaterizi	Various		10000	National	Italy	News: "DISWall. A European Project for the reinforced masonry"
		March-April 2006	Publication on technical and/or peer reviews	Publications "L'industria dei laterizi" n.98 (Clay Bricks' Industry)	ANDIL Assolaterizi	Industry; Manufacturers; Industrial associations	Scientists and researchers	5000	International	Europe	DISWALL starts the European Project for developing innovative systems for reinforced masonry walls'
		April 2006	Press events	ANDIL NOTIZIE	ANDIL Assolaterizi	Industry; Manufacturers; Industrial associations		200	National	Italy	DISWall. A European Project for the reinforced masonry
		May-June 2006	Publication on technical and/or peer reviews	Publications "Costruire in Laterizio" n.110 (Building with Clay Products)	ANDIL Assolaterizi	Architects; Engineers; Professional bodies	Scientists and researchers	25000	National	Italy	DISWall: an European Project

September 2006	Press events	ANDIL NOTIZIE	ANDIL Assolaterizi	Industry; Manufacturers; Industrial associations		200	National	Italy	DISWALL Project: meeting at University of Aachen (GERMANY)'
25-29 October 2006	Exhibitions and fairs	SAIE, International exhibition of building industrialisation		Industry; Manufacturers; Industrial associations	General public	30000	International	Europe	Brochure dedicated to Italian stakeholders, introducing DISWall Project and its main aspects of interest.
31 October 2006	Conferences and meetings	Presentation of The Italian Construction Technology Platform (PTIC)	Autostrade SpA, Università Politecnica delle Marche, Artemis srl, Università di Padova, ITC CNR, ICIE, Mapei, Leonardo 1502 Ceramica, Consorzio TRE, D'Appolonia, Politecnico di Torino, Giarc INDICI, ENEA	Industry; Manufacturers; Industrial associations	Scientists and researchers	250	National	Italy	Brochure dedicated to Italian stakeholders, introducing DISWall Project and its main aspects of interest.
February 2007	Press events	ANDIL NOTIZIE	ANDIL Assolaterizi	Industry; Manufacturers; Industrial associations		200	National	Italy	"Progetto DISWall: all'Università di Minho, Guimaraes (Portogallo), si parla di muratura armata"
3 May 2007, Bologna	Workshops and seminars	"Ricerca e Innovazione nel settore delle Costruzioni" - R2B - Research to Business	Italian Construction Technology Platform (PTIC)	Industry; Manufacturers; Industrial Associations	Scientists and researchers	50	National	Italy	Dissemination document: <u>paper</u>
4 May 2007, Bologna	Conferences and meetings	Brick Masonry Assembly, ANDIL	ANDIL Assolaterizi	Industry; Manufacturers; Industrial Associations		50	National	Italy	Info
22 June 2007, Rome	Conferences and meetings	56th General Assembly of ANDIL	ANDIL Assolaterizi	Industry; Manufacturers; Industrial Associations		100	National	Italy	Info
September 2007	Press events	ANDIL NOTIZIE	ANDIL Assolaterizi	Industry; Manufacturers; Industrial associations		200	National	Italy	"Meeting all'Università di Monaco per il 18° mese di DISWall, il progetto di ricerca sui sistemi innovativi per muratura armata "



		10 September 2007	Standardization committees	UNI Commissione "Ingegneria strutturale"-SC 6 "Strutture di muratura"		Industry; Manufacturers; Industrial Associations	Scientists and researchers	15	National	Italy	Presentation of the project to the UNI Committee
		07 September 2007	Standardization committees	TBE PG Clay Block, Amburgo		Industry; Manufacturers; Industrial Associations		25	International	Europe	Presentation of the project to the TBE Committee
		24-28 October 2007	Exhibitions and fairs	SAIE, International exhibition of building industrialisation		Industry; Manufacturers; Industrial associations	General public	30000	International	Europe	Brochure dedicated to Italian stakeholders, introducing DISWall Project and its main aspects of interest.
		October 2007	Press events	ANDIL NOTIZIE	ANDIL Assolaterizi	Industry; Manufacturers; Industrial associations		200	National	Italy	"E' COSTRUZIONE IN L'EDIFICIO PROTOTIPO DEL PROGETTO DISWALL"
		13 November 2007	Standardization committees	UNI Comitato Costruzioni, Milano		Industry; Manufacturers; Industrial Associations	Scientists and researchers	15	National	Italy	Presentation of the project to the UNI Committee
8		16-21 October 2006	Conferences and meetings	New developments in building & construction	bekaert	Industry; Manufacturers; Industrial associations		65	International	World	PPT presentation for the Bekaert organisation
		17 - 20 april 2007	Conferences and meetings	masonry seminars	bekaert	Industry; Manufacturers; Industrial associations		500	International	Europe	Murfor seminars, particularly for Eastern Europe
		15 November 2007, Lisbon	Workshops and seminars	Wall Structures II - Innovation and present possibilities	A seminar organized by Uminho and LNEC	Architects; Engineers; Professional bodies	University and training organizations	300	National	Portugal	
9		February 22nd 2006	Conferences and meetings	Technical Committee of the German Clay Brick Industry	Arge Mauerziegel	Industry; Manufacturers; Industrial associations		15	National	Germany	Presentation of the aims for the technical employees

		May 16th 2006	Conferences and meetings	Aims of the DISWALL project	Arge Mauerziegel	Industry; Manufacturers; Industrial associations		15	National	Germany	Presentation of the aims at the assembly of members
		October 18th 2006	Workshops and seminars	Aims of the DISWALL project	Arge Mauerziegel	Industry; Manufacturers; Industrial associations		10	National	Germany	Presentation of aims and first optimisation results for the technical staff of companies in earthquake prone areas
		November 9th 2006	Conferences and meetings	Unternehmertag 2006 von "Ausführung Mauerwerk"	Arge Mauerziegel	Industry; Manufacturers; Industrial associations		40	National	Germany	Presentation of possible applications based on the project
		November 22nd 2006	Conferences and meetings	Technical Committee of the German Clay Brick Industry	Arge Mauerziegel	Industry; Manufacturers; Industrial associations		15	National	Germany	Presentation and discussion of first results
		March 2007	Publication on technical and/or peer reviews	Entwicklung innovativer Systeme für bewehrtes Mauerwerk	Arge Mauerziegel	Industry; Manufacturers; Industrial Associations		1000	International	Europe	
		April 2007	Publication on technical and/or peer reviews	Halbzeit beim EU-Forschungsprojekt DISWALL	Arge Mauerziegel	Architects; Engineers; Professional bodies		1000	National	Germany	
10		30 Oct-1 Nov 2006, London	Conferences and meetings	Developing innovative systems for reinforced masonry systems', Proc. 7th International Masonry Conference, London, 30 Oct-1 Nov 2006	British Society	Scientists and researchers	Industry; Manufacturers; Industrial associations	150	International	Europe	
		January 2007	Training and Academic courses	"Neue Entwicklungen im Mauerwerkbau"	ibac	University and training organizations		50	National	Germany	
		January 2007	Prints	DISWALL – Developing Innovative Systems for reinforced masonry Walls	ibac	Scientists and researchers	Various	800	International	Europe	
		March 2007	Prints	DISWALL	Verlag Ernst und Sohn	Architects; Engineers; Professional bodies	Scientists and researchers	1500	National	Germany	+ Austria and Switzerland
		December 2007	Prints	DISWALL	Verlag Ernst und Sohn	Architects; Engineers; Professional bodies	Scientists and researchers	1500	National	Germany	+ Austria and Switzerland

11		30 Oct-1 Nov 2006, London	Conferences and meetings	Developing innovative systems for reinforced masonry systems', Proc. 7th International Masonry Conference, London, 30 Oct-1 Nov 2006	British Society of Masonry	Scientists and researchers	Industry; Manufacturers; Industrial associations	150	International	Europe	Publication
		December 2006	Prints	DISWALL – Developing Innovative Systems for reinforced masonry Walls	TU München	Scientists and researchers	Architects; Engineers; Professional bodies	100	National	Germany	+ Austria and Switzerland (newsletter)
		17.-20.2.2008, Sydney (AUS)	Conferences and meetings	14th International Brick and Block Masonry Conference	Main international 4year conference on masonry matters	Scientists and researchers	Architects; Engineers; Professional bodies	180	International	World	
12		02 Oct-03 October 2006, Lisbon	Conferences and meetings	Current research on modern masonry at university of Minho	CIB/LNEC	Scientists and researchers	Industry; Manufacturers; Industrial associations	20	International	Europe	Publication and presentation of paper
		02 Oct-03 October 2006, Lisbon	Conferences and meetings	Current research on modern masonry at university of Minho	CIB/LNEC	Scientists and researchers	Industry; Manufacturers; Industrial associations	20	International	World	Publication and presentation of paper
		3-6 June 2007, EUA	Conferences and meetings	10th North American Masonry Conference	4year International Conference organized by the North American Masonry Society	Scientists and researchers	Scientists and researchers	200	International	World	Publication and presentation of paper
		26-28 September 2007, Porto	Conferences and meetings	Sismica 2007	University of Porto	Scientists and researchers	Architects; Engineers; Professional bodies	150	National	Portugal	Publication and presentation of paper
		15 November 2007, Lisbon	Workshops and seminars	Wall Structures II - Present situation and new technologies	A seminar organized by Uminho and LNEC	Architects; Engineers; Professional bodies	Contractors, Enterprises	300	National	Portugal	Publication and presentation of paper
		19-22 December 2007, Coimbra	Conferences and meetings	Construção 2007	University of Coimbra	Scientists and researchers	Industry; Manufacturers; Industrial Associations	150	National	Portugal	Publication and presentation of paper

A.3 PUBLISHABLE RESULTS

The publishable results of the project are constituted by some document delivered during the first project year, such as D1.2 'Data base of experimental results', which can be also downloaded for free from the project website: <http://diswall.dic.unipd.it/>, by D2.1 'Project presentation' that presents a short overview of the project aims and structure, D3.1 'Report about the requirements for masonry units, reinforcement, mortar and concrete', D5.1: 'Report about the existing methods for cyclic in-plane and out-of plane testing and their development for the project aims' and D5.2: 'Report about the existing NDE methods suitable for masonry inspection, and their parameter to be calibrated for the purpose'.

Other publishable results produced during the second project year are D4.3 'Final report about the proposed technologies' that presents an overview of the construction systems and their economic assessment and, above all, the design and construction guidelines, D6.2 'Guidelines on the design for end-users' that contains the design charts (D6.1) and D7.5 'Guidelines for site organization and execution'. These deliverables have been placed as public into the Annex I to the contract 'Description of work', whereas all the other deliverables that have been produced so far are restricted. They contain information that constitute part of the exploitable results of the project and that have been described in section A.1. The other project results, were demonstrations carried out during the project (D4.2: Practical demonstration of wall construction; D5.3: Laboratory demonstration of DT and NDT methods; D7.3: Demonstration of ND testing on real masonry walls) or were restricted to other project participants.