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(54) STRUCTURE OF A LOAD-BEARING PILLAR FOR CIVIL WORKS AND RELATED BUILDING METHOD

(57) The present invention is relative to a structure of a load-bearing pillar for civil works comprising, in combination, a prefabricated formwork (1) made of composite material, a framework (2) contained inside the prefabricated formwork (1) and a solidified mass of concrete (3) confined within the prefabricated formwork (1) and embedding the framework (2).

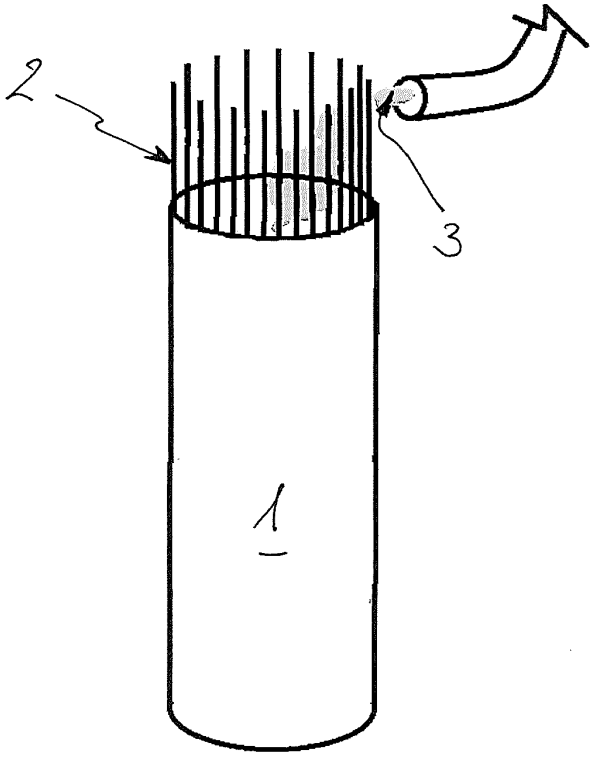

FIG.3

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Description

TECHNICAL FIELD OF INVENTION

[0001] . The present invention refers to a structure of a load-bearing pillar for civil works, in particular in the public and private building field, and to the relative building method.

PRIOR ART

[0002] . In the construction field, and in particular in the public and private building field, the building of a load-bearing column or pillar calls for the use of a formwork in which are inserted the reinforcing bars and concrete is poured to obtain the reinforced concrete structure.

[0003] . The function of the formwork is thus to hold the cast concrete, which embeds the steel reinforcement, until it is solidified and thus forms the reinforced concrete column or pillar.

[0004] . Various technologies are known that concern the use of the formwork in the civil construction industry to build columns or pillars made of reinforced concrete.

[0005] . A first technology, which is generally the most widely used, involves the so-called "disposable formwork", which is made and used a single time with low-cost materials, such as cardboard, wood, fabric or plastic materials. Once the concrete is poured and allowed to set, the formwork is removed and must be suitably disposed of as waste, depending on the type of material used.

[0006] . Another technology, also improperly defined as "disposable", consists of the use of a formwork, generally of modular type, that is reutilized for a number of times to build columns, pillars or other types of concrete products. In this case, the formwork, after the concrete in it has set, is stripped and is used again for successive concrete castings.

[0007] . A third technology, defined as "stay-in-place formwork", in which, in addition to being used as formwork to hold the concrete, the form remains in place after the concrete has set, and forms the external shell of the column. In this manner, the form becomes a permanent complementary component of the building structure, and thus also performs a protective and thermo-acoustic insulating action, for example in prefabricated residential buildings.

[0008] . EP 1942234 A2 discloses a prefabricated formwork made of polyurethane foam used for the purpose of thermally insulating the pillar and for performing a simple action of confining the concrete contained in it. However, the polyurethane foam material of the formwork is not suitable to support the loads that bear upon the reinforced concrete pillar.

[0009] . US 2016/258160 A1 refers to a particular application of a formwork of composite material comprising a first external containment element and a second internal containment element interlinked with each other according to predefined dimensioning criteria. Various linking systems are also provided to connect structural elements that are arranged at right angles to each other. The constructive method for building the formwork using the cold impregnation of the glass fibre fabric with resin during the process of production of the formwork is extremely empirical and is not capable of constantly providing the necessary guarantees of the performance characteristics of the manufactured article in terms of withstanding the flexural and compressive loads. In fact, a serious drawback of this prior art solution lies in the fact that, during the formwork building process, air bubbles can form and remain embedded in the fabric-resin mass, forming in this manner elements of discontinuity in the performance capabilities of the manufactured article.

[0010] .Although they are established and widely used, none of the above-mentioned technologies, in particular the "stay-in-place formwork" technology, considers also assigning to the formwork an effective structural function of cooperating with the concrete in the static and dynamic support of the construction, in addition to a simple covering and/or insulating function, and of providing constant and reliable performance characteristics in terms of load-bearing capacity.

SUMMARY OF THE INVENTION

[0011] . The main objective of the present invention is to overcome the drawbacks of the prior art, by devising a load-bearing pillar for civil works and a relative building method having improved capabilities of supporting static and dynamic stresses.

[0012] . In the scope of the above objective, one purpose of the present invention is to build a load-bearing pillar in which all the components cooperate to support the structure.

[0013] .Another purpose is to build a load-bearing pillar in which, thanks to the improved capabilities of supporting static and dynamic loads, it is possible to reduce its cross section or, with the same cross section, it is capable of bearing a heavier load.

[0014] . Yet another purpose is to build a load-bearing pillar that is capable of guaranteeing, both in the phase of building the manufactured article and in the course of time, consistent load-bearing performance characteristics, in particular with regard to flexural and compressive loads.

[0015] .A further purpose is to build a load-bearing pillar capable of performing an optimal and long-lasting protective function against deterioration and wear resulting from weathering and the action of external agents.

[0016] . One not secondary purpose is to devise a structure of a load-bearing pillar for civil works and a related building method that achieve the above objective and purposes at competitive costs and can be built with the usual known plants, machinery and equipment.

[0017] . The above objective and purposes, and others

that will be more apparent in the description which follows, are achieved with a load-bearing pillar for civil works as defined in claim 1 and a related building method as defined in claim 7.

BRIEF DESCRIPTION OF THE FIGURES

[0018] . Further characteristics and the advantages of the present invention will become more evident from the following description of some particular, but not exclusive, embodiments illustrated purely by way of example without limitations with reference to the enclosed figures, in which:

- figure 1 illustrates, in a front perspective view, a first component of the load-bearing pillar for civil works according to the present invention;
- figure 2 is a front perspective view of a second component of the load-bearing pillar according to the present invention;
- figure 3 illustrates the step of casting the concrete inside the components of the preceding figures, assembled together, to form the load-bearing pillar according to the present invention;
- figure 4 is a diagram illustrating the deformation of the pillar according to the present invention as a function of the applied load.

DETAILED DESCRIPTION OF THE INVENTION

[0019] . With reference to the previously mentioned figures, reference numeral 1 indicates a formwork of the "stay-in-place" kind, inside of which can be inserted a cage forming the framework 2 of the pillar, which has the task of supporting the static and dynamic traction loads acting on the pillar; the reinforcement, generally made of metallic material, can also be made with other types of materials, providing they are suitable to bear traction loads. The framework 2 includes essentially a plurality of longitudinal bars 4, held and reinforced if necessary by one or more transversal stirrups 5 surrounding the longitudinal bars. When the framework is formed with the formwork 1 and the framework 2 as shown in figure 3, the concrete 3 is cast inside the formwork 1 so as to form the load-bearing pillar of reinforced concrete once the mass of concrete 3 sets, embedding the framework 2 within it. The function of the solidified mass of concrete is, as is well known, to support the static and dynamic compression loads bearing on the structure of the pillar.

[0020] . One peculiar feature of the present invention consists of the type of formwork used: in effect it is a prefabricated formwork 1 made of composite material having mechanical, chemo-physical and aesthetic properties that may be variable based on the specific requirements and final characteristics desired for the end manufactured product, that is, the load-bearing pillar.

[0021] . The composite materials that can be used to build the prefabricated formwork 1 can be carbon fibre, aramid fibres, glass fibre, basalt or other equivalent materials, embedded in suitable resins, such as for example epoxy resin, phenolic resin, vinyl ester, etc.

[0022] .The direction of the fibres in the different layers forming the composite material will be the most suitable, depending on the loads to support and on the desired results.

[0023] . Thus, the prefabricated formwork 1 made of composite material forms a structural element that integrates the load-bearing pillar, cooperating with the concrete 3 and the framework 2 to support the loads that bear down on the pillar, in particular the compressive loads.

[0024] .The resulting technical effect of foreseeing, in combination, a prefabricated formwork 1 of composite material in which is confined a casting of solidified concrete 3 reinforced with the framework 2 is to considerably increase the strength of the load-bearing pillar to withstand the compression-flexion forces acting on the pillar, thanks to the interaction between the formwork and the concrete. In fact, in the presence of major compressive stresses, the concrete suffers only partial micro-cracking, thanks to the effect of inhibition of further propagation of the cracking inside the concrete exercised by the formwork of composite material, which also absorbs a significant part of the load that impinges on the concrete and is transferred to the formwork. In this manner, the capacity of the pillar to support a compressive load is considerably increased.

[0025] . Experimental tests, illustrated in the diagram of figure 4, where the axis of the abscissas indicates the deformation and the axis of the ordinates indicates the applied load, showed a compressive strength capacity up to three times greater than that of a normal pillar made of reinforced concrete alone. The diagram of figure 4 also evinces the behaviour under stress of the pillar according to the present invention, which is essentially linear up to the breaking point in the stress range in which the confining action of the composite formwork comes into effect.

[0026] . The composite material with which the prefabricated formwork 1 is built exercises a confining action on the concrete, thus considerably increasing, as seen above, the load-bearing capacity of the pillar, especially in the case of columns of round cross section in which the radial distribution of the load of concrete on the composite material is substantially uniform.

[0027] . This makes it possible to reduce the load-bearing cross section of the pillars, with resulting economy in the cost of the concrete and a reduction of the weight bearing down upon the supporting structures or, with the same cross section, to build pillars that are capable of carrying a considerably greater load.

[0028] . Furthermore, as it also exercises a lateral confining action on the longitudinal framework 2 of the pillar, the prefabricated formwork 1 can eliminate or reduce the necessity of laterally stirrupping the bars of the framework 2 since it is capable of preventing the sideways tilting of the framework 2 resulting from the vertical and

horizontal loads to which the pillar is subjected. This results in both a reduction of the cost of the framework and of the times required to build it.

[0029] . A further technical effect is connected to the protective and lasting action against weathering agents and the external environment played by the prefabricated formwork 1 of composite material on the pillar; this makes it possible to eliminate, or at least reduce, the thickness of the concrete cover and to use normal concrete without additives even in particularly aggressive environments, such as is found near seashores or on coastlines. The prefabricated formwork 1 of composite material plays in fact a protective action in preventing the occurrence of carbonation and oxidation of the framework 2, phenomena to which the framework is particularly sensitive if it is built with steel or other metallic materials, since the external thickness of the composite material has the action of insulating the concrete.

[0030] . The method of prefabricating the formwork of composite material makes it possible to achieve controlled and consistent performance with regard to the load-bearing capacity of the formwork-concrete assembly forming the pillar, since both the performance characteristics of the raw material used, made up of the pre-impregnated composite (for example, pre-impregnated carbon), and the subsequent operating steps of laying the fibres and baking the manufactured article in a controlled atmosphere are completely controllable and predetermined. The achievement of specific characteristics of strength in accordance with requirements can in fact be determined in a precise manner on the basis of the number and thickness of the layers of composite material, as well as the quality of the concrete used.

[0031] . The prefabrication of the formwork 1 of composite material also enables a considerable reduction of the times for setting up the structure, thanks also to the possibility of prearranging the longitudinal bars of the framework 2 inside the formwork 1 before its installation in the designated place.

[0032] . A further aspect of the present invention lies in the fact that the last layer of the composite material making up the prefabricated formwork 1, that is, the layer that remains in view after the completion of the work, may consist of a finish or a material that is capable of lending appreciable aesthetic characteristics to the column without requiring any additional work. In addition to the artificial fibres - carbon, aramid, etc. - of the composite material, the last layer can be made of natural fibres (for example, cotton, jute, silk ...), plastic or stainless-steel laminates, various types of wood veneers, etc. If necessary, this external layer can be lined with a protective film to avoid damage during the setting-up operations.

[0033] .The method of building the load-bearing column according to the present invention comprises essentially the steps of installing and setting up the prefabricated formwork 1, inserting the steel framework 2, or pre-assembling the framework 2 inside the formwork 1 before its installation and arrangement, casting the concrete 3 inside the formwork 1, and allowing the subsequent setting of the concrete confined inside the formwork 1, which forms an integral and structural part of the column.

[0034] . From the above, it is therefore evident how the present invention achieves the initially foreseen purposes and advantages: in fact, a structure has been devised for a load-bearing pillar for civil works and a related building method capable of providing improved resistance to static and dynamic stresses thanks to the effect of the structural cooperation between the prefabricated formwork 1 of composite material and the reinforced concrete.

[0035] . Thanks to the increased load-bearing capacity, it is possible to reduce the cross section of the pillar, with consequent reduction of costs and of the weight bearing down upon the underlying structures or, with the same cross section, the pillar is capable of supporting heavier loads compared to pillars made according to the prior art.

[0036] .Another advantage of the pillar according to the present invention lies in the capacity of guaranteeing consistent load-bearing performance characteristics, in particular to flexural and compressive loads, both in the phase of building the manufactured article and in the course of time.

[0037] . In addition, the formwork 1 is capable of performing an optimal and long-lasting protective function against the deterioration and wear of the pillar caused by weathering and the action of external agents.

[0038] . Naturally, the present invention is amenable to numerous applications, modifications and variants without thereby departing from the scope of patent protection as defined in independent claims 1 and 7.

[0039] . In addition, the materials and equipment used to implement the present invention, as well as the shapes and dimensions of the individual components, can be the most suitable for the specific requirements.

Claims

1. Structure of a load-bearing pillar for civil works, **characterized in that** it comprises, in combination, a prefabricated formwork (1) made of composite material, a framework (2) contained inside said prefabricated formwork (1) and a solidified concrete mass (3) confined inside said prefabricated formwork (1), said framework (2) being incorporated into said solidified concrete mass (3).

2. Structure of a load-bearing pillar as in claim 1, wherein said prefabricated formwork (1) made of composite material forms an integral and structural element of said load-bearing pillar.

3. Structure of a load-bearing pillar as in claim 1, wherein said framework (2) is essentially formed by a plurality of longitudinal rods (4).

4. Structure of a load-bearing pillar as in claim 1, wherein said prefabricated formwork (1) made of composite material cooperates with said framework (2) and said solidified concrete mass (3) to bear the loads acting on said load-bearing pillar.

5. Structure of a load-bearing pillar as in claim 4, wherein said prefabricated formwork (1) made of composite material cooperates with said framework (2) and said solidified concrete mass (3) to bear the compression and/or flexural loads acting on said load-bearing pillar.

6. Structure of a load-bearing pillar as in claim 5, wherein said prefabricated formwork (1) made of composite material cooperates with said solidified concrete mass (3) to prevent the diffusion of cracking inside said solidified concrete mass (3) and to partially bear the loads acting on said solidified concrete mass (3) when said load-bearing pillar is subjected to said compression and/or flexural loads.

7. Structure of a load-bearing pillar as in claim 1, wherein said framework (2) is pre-assembled and contained inside said prefabricated formwork (1).

8. Use of a structure of a load-bearing pillar for civil works as any of claims 1 to 7.

9. Process for building a structure of a load-bearing pillar for civil works as in claim 1, **characterized in that** it consists of the following steps:

- installing and setting up a prefabricated formwork (1) made of composite material;
- putting inside said prefabricated formwork (1) a framework (2) essentially comprising a plurality of longitudinal rods (4);
- performing a concrete casting inside said prefabricated formwork (1);
- forming said load-bearing pillar through hardening said concrete casting so as to obtain a solidified concrete mass (3) confined inside said prefabricated formwork (1) made of composite material and incorporating said framework (2).

10. Process as in claim 9, wherein said framework (2) is pre-assembled and contained inside said prefabricated formwork (1) before installing and setting up said prefabricated formwork (1).

11. Use of a process for building a structure of a load-bearing pillar for civil works as any of claims 9 to 10.

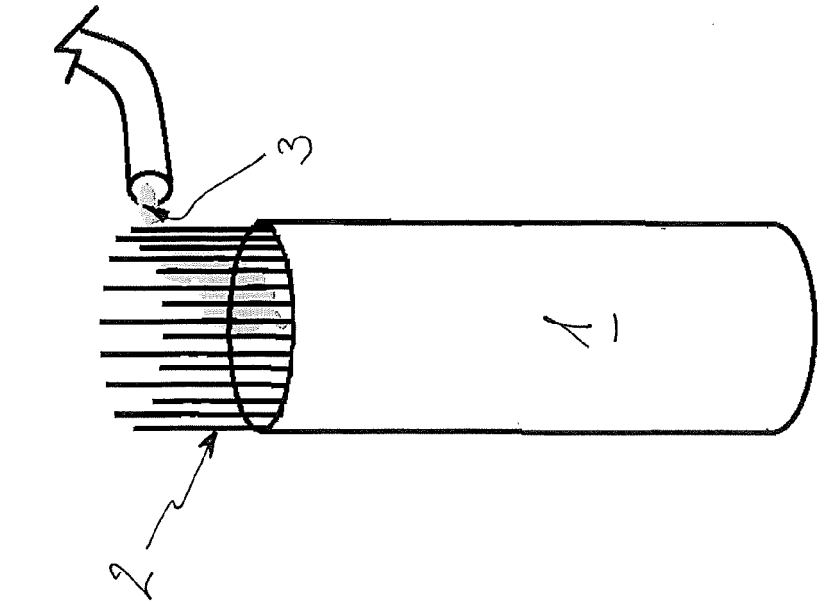

FIG.3

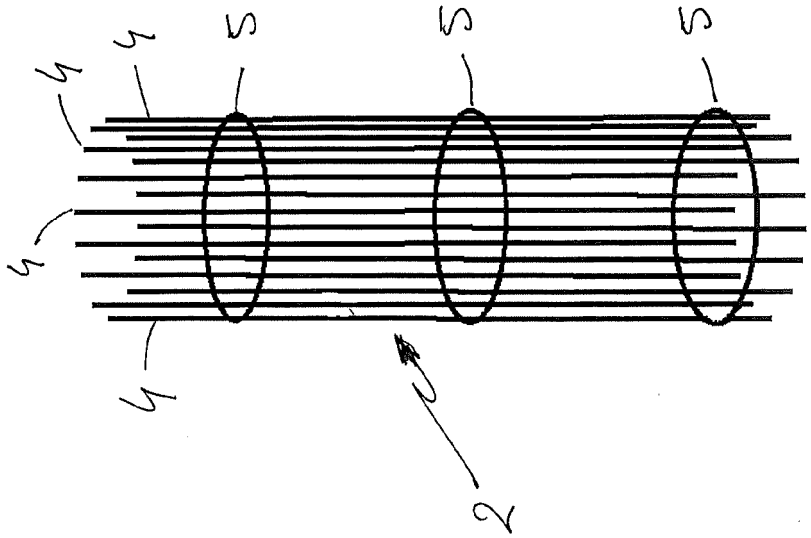

FIG.2

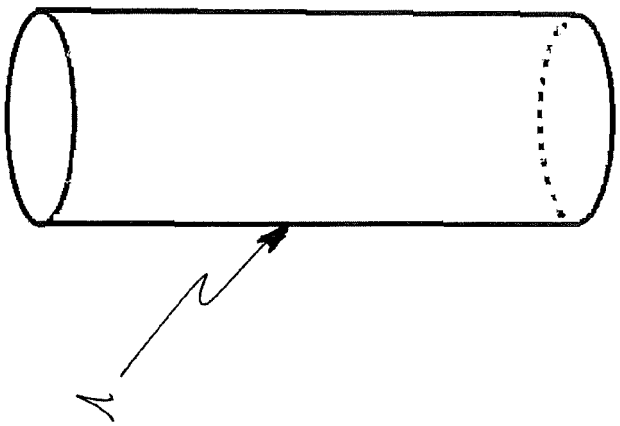

FIG.1

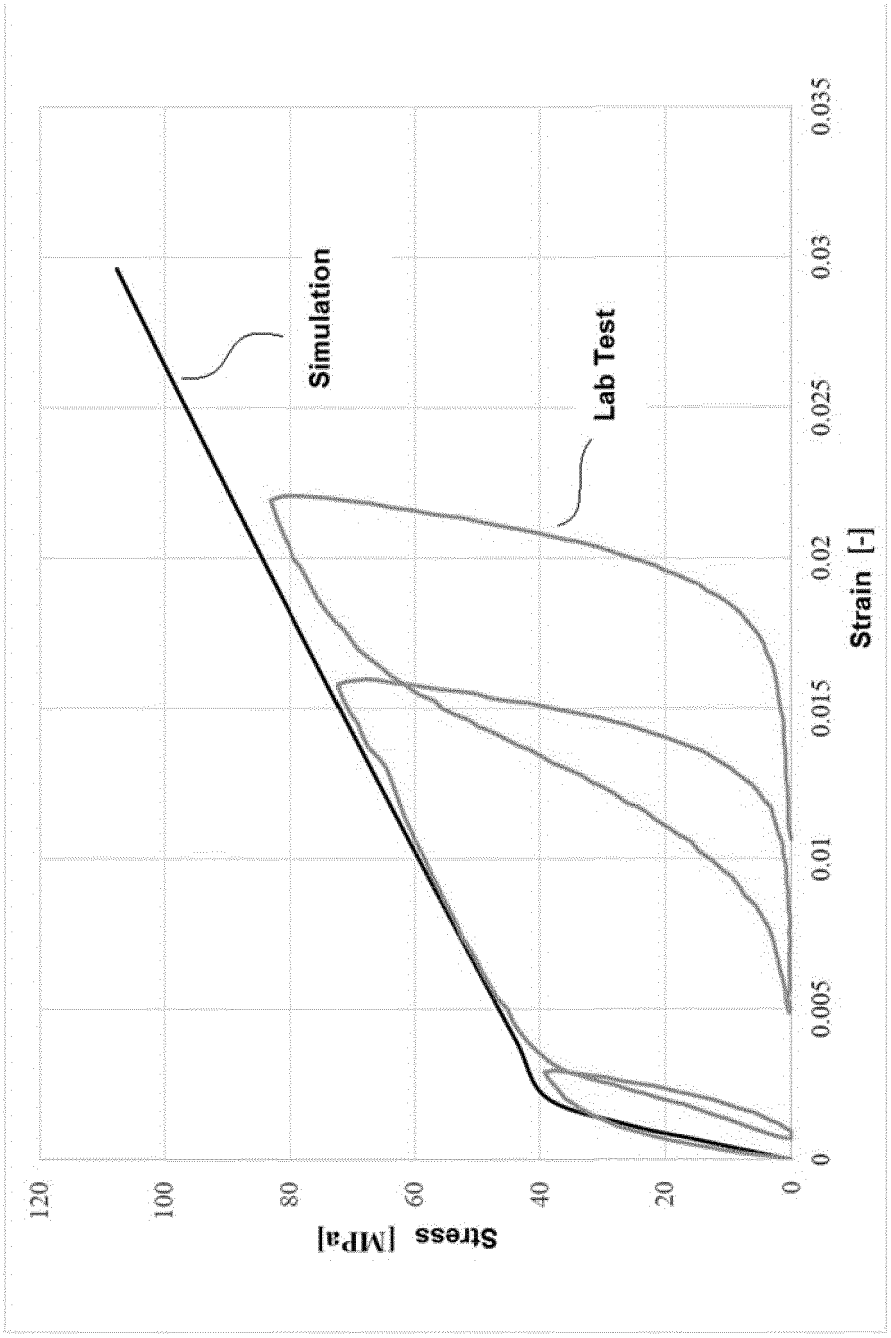
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FIG. 4

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EUROPEAN SEARCH REPORT

Application Number
EP 18 15 4232

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	5 April 2018	Vratsanou, Violandi

CATEGORY OF CITED DOCUMENTS

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