PATENTS EXAMINATION BOARD

PRACTICAL LEGAL PROBLEMS

EXAMINATION: JUNE/JULY 2025

PAPER 1

EXAMINERS: A LEWIS
T BALL

MODERATOR: J WHITTAKER

DURATION: READING TIME – **1 Hour**
EXAMINATION TIME – **4 Hours**
TOTAL: **5 Hours**

This paper also includes 6 annexures, namely:

(i) Annexure A – Specification of ZA 2018/08751;

(ii) Annexure B – Claims of European family Application No. 17380003.3, as allowed;

(iii) Annexure C – Official Action issued by the European Patent Office in respect of European Patent Application No. 17380003.3;

(iv) Annexure D – WO 2017/046624 A1

(v) Annexure E – *Letter of Demand*

(vi) Annexure F – Application for Revocation

Instructions:

- Answer all three questions; and
- Write legibly.

NOTES TO CANDIDATES:

1. Attached to the paper are copies of the following documents:
   (i) A copy of the Patents Act No. 57 of 1978;
   (ii) A copy of the Patent Regulations 1978; and
   (iii) A copy of the Uniform Rules of the High Court under the Superior Courts Act 10 of 2013 (Rules 6, 14, 17, 18, 19, 21, 22, 23, 24, 25, 30, 35, 36, 37 and 63).
2. Each candidate is also allowed access to (1) one dictionary during the exam.
3. Prior to handing out of the answer papers, candidates will have an opportunity to read the above documents and make notes for 60 minutes.
4. Where appropriate, reference should be made to case law, and conclusions should be supported by reasons and arguments.

BACKGROUND TO ALL QUESTIONS:

You are a patent attorney at Smart & Smarter Patent Attorneys, and receive the following letter from your client, Wind Up Energy (Pty) Ltd:

"Dear Smart & Smarter Patent Attorneys,

*Wind Up Energy is the proprietor of South African patent no. 2018/08751, titled "Wind Turbine Tower with Reinforcing Elements" (**"the patent"** or **"the South African patent"**), a copy of the specification of which is attached, marked **Annexure A**. The patent relates to reinforcing elements present along the height of a concrete wind turbine tower, which function to counteract the shear forces experienced by wind turbines in their normal operation.*

Wind Up Energy relies on the patent to protect its commercial position in the South African market. In this regard:

- *Wind Up Energy operates in the South African market as an original equipment manufacturer (**"OEM"**) in the wind power market. Wind Up Energy has been present in the South African market since 2010, and is now the market leader, with a 30% share of the total installed wind power capacity in the region. Between its office locations and the operational sites, there are more than 160 employees in South Africa working as part of the Wind Up Energy team.*
- *Wind Up Energy's customers in South Africa are primarily Independent Power Producers (**"IPPs"**), who bid to supply power to Eskom pursuant to tenders issued under the South African government's Renewable Energy Independent Power Producer Programme (**"REIPPP"**).*
- *Wind Up Energy does not supply towers to other wind power OEMS but supplies its towers as part of the total equipment package offered to IPPs. The precast concrete segments (also referred to as "keystones") used in the construction of wind turbine towers supplied by Wind Up Energy are made either by Wind Up Energy itself, in production facilities that it sets up locally, or by local precast concrete manufacturers, using molds and manufacturing information and processes supplied by Wind Up Energy, and under Wind Up Energy's control.*
- *In an effort to stimulate local manufacturing and production in the renewable energy value chain, the bid criteria in the REIPPP have required projects to commit to at least 40% local content during construction. This minimum content restriction is a qualifying threshold, and any bids not meeting this threshold would be automatically disqualified. Much of the required equipment cannot currently be made in South Africa (whether for technical or economic reasons), and there is therefore considerable pressure on IPPs and their OEMs to identify components that can be viably produced in South Africa, and include these components in their bids to meet the qualifying thresholds.*
- *Wind turbine towers are most commonly manufactured from steel, and less commonly, concrete. Both steel and concrete towers can be produced locally, but – for reasons beyond the scope of this discussion – locally produced steel towers are significantly more expensive than imported steel towers. Wind Up Energy's ability to supply locally made concrete towers at competitive prices (relative to locally made steel towers) places it in a strong position to offer OEM*

packages that are attractive to IPPs in the context of the REIPPP bid adjudication criteria discussed above;

- *Producing a concrete wind tower is, however, technically difficult. Wind turbine towers must be built to last between 20 and 35 years, while being subjected to harsh environmental conditions. The process of designing, prototyping, testing and certification of wind turbine towers is an involved process, taking a considerable amount of time (typically 6 to 12 months). In contrast, bids under the REIPPP must be submitted within a brief window following advertisement of invitations to tender – typically only 3 months. It is therefore not reasonably possible to design a tower and obtain the necessary certification within the time from advertisement until a bid must be submitted. Although bids are not limited to a particular tower design, the particular design is important to costing and the ability of the supplier to manufacture. Any significant changes are likely to require going through the lengthy process of design, prototyping, testing and certification;*

*The patent claims priority from European Patent Application No. 17380003.3 (**"the EP application"**), with a priority date of 14 December 2017.*

The body of the specification of the South African patent is the same as the specification of the EP application.

*However, in prosecuting the EP application, the European Patent Office (**"EPO"**) examiner required that the claims of the EP application be amended to the form set out in **Annexure B**. While Wind Up Energy agreed to make amendments to satisfy the EPO examiner, it did so for expedience (so that the patent would proceed to grant faster) and not because it believed that the EPO examiner's objections had merit. The EPO examiner's reasons for requiring limitation of claim 1 of the European patent are apparent from the EPO search opinion, a copy of which is attached hereto as **Annexure C**. A copy of WO 2017/046624 A1, cited by the EPO examiner, is attached as **Annexure D**.*

However, with respect to the EPO examiner,

- *Firstly, it is significant that, in paragraph 2.1, the EPO examiner omits the preceding wording, which makes it clear that the claimed invention is a wind turbine tower in which the reinforcing elements [placed in the vertical joints] are configured to provide the different shear strength in the upper and lower regions; and that the maximum shear forces to be borne are in the vertical joints.*
- *In this context, the invention is not concerned with differences in shear strength arising from differences in cross-section of a tapering tower, but rather in differences in shear strength arising from differences in configuration of the reinforcing elements.*
- *Furthermore, the EPO examiner then states that "as the wind speed varies with the height, the shear strength usually changes as well". However, it is the shear force on the tower that changes with height due to increased wind speeds higher up the tower; and it is not inherent or inevitable that reinforcing elements in the vertical joints would therefore be differently configured at different heights to produce different shear strength values. Indeed, none of the prior art*

documents considered by the examiner shows any variation in configuration of the reinforcing elements according to height to deal with the different shear forces applicable in the vertical joints at different heights.

- *Finally in this regard, I mention that family patents have been granted for the invention in a number of other jurisdictions where the patent office conducts a substantive examination before grant, including ARIPO, Australia, Chile, and the USA. In some jurisdictions, amendments similar to those made in the European application were made to expedite grant of a patent. However, in other jurisdictions, the claims were not amended in prosecution, and remain in the same form as in the South African patent.*

*On 26 March 2025, we received a Letter of Demand from Tough Guy Patent Attorneys, on behalf of Two Towers Manufacturing (Pty) Ltd (**"Two Towers Manufacturing"**), a copy of which is attached as **Annexure E**. We did not respond immediately to the letter, as our in-house legal team was unconvinced by the case for invalidity of the patent made out in the letter, and the company did not expect that Two Tower Manufacturing would proceed with its plan to infringe the patent without receiving the requested undertaking.*

*Then, on 17 June 2025, we received an application for the revocation of the South African Patent. A copy of the application is attached as **Annexure F**.*

For further information,

- *Both Wind Up Energy and Goldstar (Proprietary) Limited (**"Goldstar"**), acting as OEMs, submitted competing bids to supply towers to a company called Power Trip Electricity (**"PTE"**) for a project known as "III Wind 1". Goldstar's bid included concrete towers to be supplied by Two Tower Manufacturing.*
- *PTE was ultimately successful in its bid, which was based on equipment supplied by either Goldstar or Wind Up Energy according to their bids to it. The award was made in October 2024;*
- *PTE informed Wind Up Energy on 10 January 2025 that it was proceeding with Goldstar's bid on the III Wind 1 project, but would proceed with a bid from Wind Up Energy on a different project, known as "III Wind 2". Although it had suspicions, Wind Up Energy did not know whether Two Tower Manufacturing would infringe Wind Up Energy's patents, in supplying Goldstar;*
- *Wind Up Energy would likely have been successful over Goldstar in its bid to supply PTE on the III Wind 1 project if Two Tower Manufacturing had not tendered to supply Goldstar with locally-made concrete towers;*
- *Two Tower Manufacturing has not yet begun construction of the towers, but must start doing so imminently if it is to deliver the towers in time for the project timeline without incurring significant late-delivery penalties.*
- *We believe that Two Towers Manufacturing only discovered the existence of the patent after it was awarded the III Wind 1 project, once it was too late to redesign its towers to avoid infringement and go through the process of prototyping, testing and certification of the towers in time to deliver them for use in the project;*
- *Although it would not be easy for Two Towers Manufacturing to adopt a different, non-infringing design at this late stage, there are a number of*

alternatives to the patented invention, which Two Tower Manufacturing could substitute into its wind turbine tower designs. (On the other hand, if it is not possible for Two Tower Manufacturing to adopt a non-infringing design, we believe that this would only confirm the harm suffered by Wind Up Energy as a result of the infringement);

- *Two Towers Manufacturing does not have sufficient assets to cover a damages claim by Wind Up Energy, if the validity of the patent is upheld in the revocation application, and they are found to have infringed the patent; and*
- *Although we understand that Wind Up Energy may still have an infringement claim against PTE, we would naturally be very reluctant to pursue a claim against PTE, which is a customer of Wind Up Energy on other projects.*

Please advise us.

Wind Up Energy"

QUESTION 1: (30 marks)

Provide your client with detailed advice on the validity of the patent.

QUESTION 2: (40 marks)

Provide your client with detailed advice on a proposed approach to enforcing the patent against infringement and/or defending the patent against the challenge to its validity in light of your advice in question 1, to best serve your client's interests.

QUESTION 3: (30 marks)

Draft a counterstatement to the revocation application in light of your answers to questions 1 and 2.

Annexure A

WIND TURBINE TOWER WITH REINFORCING ELEMENTS

OBJECT OF THE INVENTION

The present invention provides a wind turbine tower. The proposed wind turbine tower comprises at least a section comprising at least two precast segments forming at least a vertical joint and at least two reinforcing elements in said vertical joint. The reinforcing elements provide at least a first shear strength and a second shear strength along the height of the at least a section of the tower.

BACKGROUND OF THE INVENTION

The goal of wind energy consists of generating electricity from the wind through wind turbines with maximum efficiency and minimum cost. These wind turbines comprise basically a tower, a nacelle that houses the electric generator and a rotor comprising three blades.

The tower is in charge of supporting all elements located in the nacelle and transmitting both the aerodynamic and operating conditions forces to the foundation.

Some towers are made of reinforced concrete modular sections. Each section comprises at least two segments and the joining surface between segments is called vertical joint.

Performing a vertical joint has technical difficulties because the shear strength of concrete is not enough to bear shear forces distribution along the vertical joint. Consequently, reinforcing elements have to be disposed embedded in the concrete of the vertical joint. Said elements confer enough shear strength to the vertical joint.

The setting of the vertical joints is a bottleneck in the process of wind turbine tower assembly. Usually, the connection of these segments requires pouring mortar within vertical joints for them to achieve the required resistance. There are also other alternatives such as dry joints, post-tensioned systems, etc.

Specifically, the process of pouring mortar (grouting) in vertical joints involves the use of auxiliary elements called formworks, usually attached to adjacent segments, to retain the mortar that has been poured. The placement of said formworks is made on the worksite, once the precast segments are positioned to form a section according to dimensional tolerances, and it requires several hours. When the mortar is hardened these elements are removed.

Traditionally mortar is poured by gravity in the vertical joints taking advantage of the gravitational action which facilitates the filling of this type of joint. However, because of the

high hydrostatic pressure generated by the column of mortar, leakages can appear. That would make the finish surface of the joints of the precast segments to be irregular.

Another technical problem is that the formworks need to be temporarily fastened to the precast segments to guarantee its position and unfasted once the hardening phase finishes on each vertical joint. All of these operations and auxiliary tools increase the cost of the tower.

Furthermore, during the pouring and mortar hardening stages, it is necessary to ensure minimum conditions of temperature (at least 5°C) in both the precast segments in order to ensure a proper curing of the mortar, otherwise, its mechanical properties (strength) could be affected.

From the state of the art there are known alternative solutions which avoid the use of mortar in the vertical joints. For example, document JP5827102 describes an installation method of a precast member comprising a step of connecting a first precast member having a first hole part capable of housing a connecting rod to an existing concrete structure; a step of connecting a second precast member having a second hole part into which the distal end side of the connecting rod can be inserted to the existing concrete structure so as to be adjacent to the first precast member; a step of sliding the connecting rod housed in the first hole part in the direction of the second precast member, and inserting the distal end side of the connecting rod to the second hole part; and a step of packing a liquid filler in the first hole part and the second hole part after sliding the connecting rod.

Another document, i.e. CN203783827, describes a wind tower member longitudinal seam precast concrete structure. It comprises a first cylinder wall and a second cylinder wall. The longitudinal joint contact faces of the first cylinder wall and the second cylinder wall are respectively provided with locating keys distributed at intervals. A locating key groove matched with the corresponding locating key is arranged between every two adjacent locating keys. A connecting hole channel is reserved in each locating key. A steel pipe is buried in the hole channel. After the locating keys are aligned with the locating key grooves, steel pipes in all the hole channels in the locating keys are located at the same vertical position, and through holes in the steel pipes vertically penetrate in the vertical direction. A steel bar is inserted in the through hole penetrating through each steel pipe.

Also, ES2545038 discloses a system comprising the steps of obtaining a profile extruding from truncated cone sections that conform as much as possible to the ideal curved profile of the tower; using pre-stressed cables, which are factory-tensioned before installing the rebar, and tendons that pass through the arch stones, making it possible to link various arch stones with one another; and reducing the thickness of the arch stones; and arranging the rebar in only

one layer. Other examples according to the prior art are available in documents : WO 2017/046624 A1 , EP 3 187 658 A1 , US 2013/025229 A1 , US 2010/281818 A1 .

DESCRIPTION OF THE INVENTION

The present invention discloses a wind turbine tower with reinforcing elements according to the subject matter described in independent claim 1. The essential feature of the present invention is that the reinforcing elements provide at least a first shear strength and a second shear strength along the height of the at least a section of the tower, the first shear strength and the second shear strength having different values and being enough to bear a maximum expected shear force in the vertical joints.

The wind turbine tower comprises at least two segments defining at least two vertical joints disposed between the at least two segments and the tower comprises at least an upper region disposed above at least a lower region.

The shear strength of the vertical joints along the height of the tower is, according to the present invention, greater in the upper part of the tower than in the lower part of the tower.

In a preferred embodiment of the invention, the reinforcing elements are selected between horizontal rebars and curved bolts, known from the state of the art. The term cross section or diameter is used indistinctly throughout the description since in this case the cross section of the horizontal rebars and curved bolts is a circle. Taking into account factors such as the number of reinforcing elements, the size of the cross section (diameter) and the distance between reinforcing elements along the height of the tower, as it will be described later, it is possible to reach a certain value of shear strength.

There are several options to achieve said certain value of shear strength:

- with reinforcing elements having a first diameter and separated from each other by a first distance along the height of the vertical joint;
- with reinforcing elements having a second diameter and separated from each other by a second distance along the height of the vertical joint, the second diameter being smaller than the first diameter and the second distance being shorter than the first distance;
- or with groups of reinforcing elements separated from each other by a third distance along the height of the vertical joint, each group placed substantially at the same height and each reinforcing element of the group of reinforcing elements having a third diameter smaller than the first diameter, the third distance being dependent on the

equivalent cross section of the group of reinforcing elements for a certain level of shear strength.

The present invention is aimed at providing reinforcing elements with a separation between them and an adequate cross-section to bear the shear force required at each height of the tower. An associated advantage is that material is saved.

In an embodiment of the invention the number of reinforcing elements per tower section (generally uniformly separated) and its diameter is defined for each section. In this case, the cross-section and/or distribution of the reinforcing elements are respectively equal and constant along the height of all the vertical joints of a same tower section and are different between different tower sections, in such a way that the maximum value of shear strength needed in the vertical joint for each tower section is achieved, but not a higher value corresponding to the shear strength of another tower section, for example, a higher tower section. The maximum value of shear strength of each tower section determines the design of the reinforcing elements (cross-section and/or distribution).

The reinforcing element or elements placed in the upper region of the tower provide the first shear strength and the reinforcing element or elements placed in the lower region of the tower provide the second shear strength.

In a preferred embodiment, the first shear strength value is greater than the second shear strength value.

According to the particular shear force distribution along the vertical joint the present invention describes a specific configuration of the reinforcing elements along the height of the tower.

The wind turbine tower with reinforced elements proposed provides an optimized solution in terms of shear strength.

DESCRIPTION OF THE DRAWINGS

To complement the description being made and in order to aid towards a better understanding of the characteristics of the invention, in accordance with a preferred example of practical embodiment thereof, a set of drawings is attached as an integral part of said description wherein, with illustrative and non-limiting character, the following has been represented:

Figure 1 Shows a wind turbine tower section with reinforcing elements.

Figure 2 Shows a representation of the shear force distribution along the vertical joint of the tower due to maximum shear force (dashed line) experienced by the tower, the shear force distribution along the vertical joint of the tower due to maximum

torque (dotted line) experienced by the tower and the minimum shear strength (thick line) to be obtained with the reinforcing elements.

Figure 3 Shows a representation of the shear force distribution along the vertical joint of the tower due to maximum shear force (dashed line) experienced by the tower, the shear force distribution along the vertical joint of the tower due to maximum torque (dotted line) experienced by the tower and the shear strength (thick line) obtained with reinforcing elements in a wind turbine tower of the state of the art that is over dimensioned.

Figure 4 Shows a representation of the shear force distribution along the vertical joint of the tower due to maximum shear force (dashed line) experienced by the tower, the shear force distribution along the vertical joint of the tower due to maximum torque (dotted line) experienced by the tower and the shear strength (thick line) obtained with reinforcing elements in an upper region and in a lower region of the tower in an embodiment of the invention.

Figure 5 Shows a representation of the shear force distribution along the vertical joint of the tower due to maximum shear force (dashed line) experienced by the tower, the shear force distribution along the vertical joint of the tower due to maximum torque (dotted line) experienced by the tower and the shear strength (thick line) obtained with reinforcing elements in an upper region and in a lower region of the tower in another embodiment of the invention.

Figure 6 Shows an embodiment of the invention comprising a wind turbine tower section wherein the upper part of the tower is more reinforced than the lower part. The distance between the reinforcing elements of the upper region is smaller than the distance between the reinforcing elements of the lower region while the diameter of the reinforcing elements of both regions is equal.

Figure 7 Shows another embodiment with a comparison between the cross-section of a reinforcing element of the upper region and the cross-section of a reinforcing element of the lower region.

Figure 8 Shows a wind turbine tower with reinforcing elements comprising two sections.

Figure 9A -C Shows different embodiments of the wind turbine tower with reinforcing elements along the vertical joint to show the number and distance between reinforcing elements in an upper region and lower region of the wind turbine tower.

Figure 10 Shows a wind turbine tower with reinforcing elements comprising six sections.

Figure 11 Shows a wind turbine tower with reinforcing elements in an embodiment in which the number and distribution of reinforcing elements are a function of the height of the tower.

Figure 12 Shows a section of the wind turbine tower and a zoom view of a reinforcing element which in this case is a curved bolt.

Figure 13 Shows a reinforcing element, which in this case is a rebar, embedded between two segments.

PREFERRED EMBODIMENTS OF THE INVENTION

A description of some embodiments of the present invention is made according to figures 1 to 13 .

The wind turbine tower with reinforcing elements comprises, as illustrated in figure 1 , at least a first section (1) comprising at least two segments (2) defining at least two vertical joints (3) disposed between the at least two segments (2). It also comprises at least two reinforcing elements (4) placed in each vertical joint (3) and at least an upper region (5) disposed above at least a lower region (6).

The essential technical feature of the wind turbine tower is that the reinforcing elements (4) are configured to provide a first shear strength (1ss) in the at least upper region (5) and a second shear strength (2ss) in the at least lower region (6). The first shear strength (1ss) and the second shear strength (2ss) have different values and are enough to bear a maximum expected shear force in the vertical joints (3).

The maximum expected shear force in the vertical joints (3) depends on the geometry, the material, the configuration, the installation, etc. of the wind turbine tower.

The number and diameter of the reinforcing elements (4) needed to bear the shear forces at each tower height shall be enough to cover the active loads expected at said tower height. In an embodiment of the invention, the vertical joints (3) of the upper part (5) of the tower are more reinforced than the vertical joints (3) of the lower part (6). On this regard, in a preferred embodiment of the invention, the first shear strength (1ss) is greater than the second shear strength (2ss).

Figure 2 shows a graphic in which the relationship between the maximum shear force in kN/m (X axis) and the height of the tower in m (Y axis) has been represented; it also shows the

relationship between the shear strength in kN/m (X axis) and the height of the tower in m (Y axis) provided by the reinforcing elements in one embodiment. In the graphic it has been also represented the minimum shear strength needed.

The shear strength curve of figure 2 has been adjusted to the maximum of both curves representing the relationship between the maximum shear and shear strength along the height of the tower. In this solution, the wind turbine tower comprises a plurality of reinforcing elements (4) with different diameters and/or different distances between reinforcing elements along the height of the tower.

This embodiment is possible but not preferred because the manufacture process is more time consuming. Preferably, the reinforcing elements (4) are configured in such a way that at least two different zones are created, one of them with a first shear strength (1ss) and the other with a second shear strength (2ss).

Figure 3 has been included to show a configuration of a wind turbine tower comprising reinforcing elements (4) with a uniform distribution and those reinforcing elements (4) being of the same size. In this case, the reinforcing elements (4) in the lower part of the tower are oversized because they are all configured to bear the value of maximum shear force of the tower (which, according to the graphics is only reached at the tower top).

In figure 4 there has been represented an embodiment of the invention wherein the cross-section and distribution of the reinforcing elements (4) do not change along the height of the tower sections up to 60 m but in sections 60 to 80, 80 to 100 and 100 to 120 m is different.

In figure 5 a graphic has been depicted showing the relationship between the maximum shear force in kN/m (X axis) and the height of the tower in m (Y axis); and the relationship between the shear strength in kN/m (X axis) provided by the reinforcing elements in one embodiment and the height of the tower in m (Y axis). In this case, it has also been represented a function showing the first shear strength (1ss) which in this case is achieved in the highest part of the tower and the second shear strength (2ss). As can be appreciated in the graphics, the function showing the first and the second shear strength (1ss, 2ss) is always over the maximum expected shear force. This embodiment of the invention is even more optimized (in terms of less time consuming during the manufacturing process) than the embodiment shown in figure 4 .

In another embodiment of the invention, the number of reinforcing elements (4) per meter in the at least upper region (5) is higher than the number of reinforcing elements (4) per meter in the at least lower region (6).

As shown in figure 6 , in an embodiment of the invention, there are at least two reinforcing elements (4) in the upper region (5) and at least two reinforcing elements (4) in the lower region (6). In this embodiment the upper part of the tower is more reinforced than the lower part, a first distance (D1) between reinforcing elements (4) of the upper region (5) is smaller than a second distance (D2) between reinforcing elements (4) of the lower region (6), while the diameter of the reinforcing elements (4) of both regions is equal.

In the present invention, by adapting the diameter of the reinforcing elements (4), the number and the distance between them it is possible to modify and better adapt the resistance capacity of the reinforcing elements (4) against the expected shear forces.

As previously described, the shear strength depends on the position of the reinforcing elements (4) and also on their measures. On this regard, in an embodiment of the invention, the cross-section of the reinforcing elements (4) of the upper region (5) is bigger than the cross-section of the reinforcing elements (4) of the lower region (6). The comparison between the cross-section of a reinforcing element (4) of the upper region (5) and the cross-section of a reinforcing element (4) of the lower region (6) can be appreciated in figure 7 .

In an embodiment of the invention, as shown for example in figure 1 , the upper region (5) and the lower region (6) are located in the at least first section (1). However, in figure 8 it has been represented an exemplary wind turbine tower in which the tower further comprises a second section (7) located above the first section (1) and in that the at least upper region (5) is located in the second section (7) and the at least lower region (6) is located in the first section (1).

In figures 9A -C different embodiments of sections of a reinforced vertical joint of the tower wherein the upper part of the tower is more reinforced than the lower part are shown. In these cases the reinforcing elements (4) of the upper region (5) of the tower provide a first shear strength (1ss) greater than the second shear strength (2ss) of the lower region (6) of the tower.

Specifically, in figure 9A it has been represented an embodiment of the wind turbine tower with reinforcing elements (4) in which the first distance (D1), which is the distance between reinforcing elements (4) of the upper region (5) is smaller than the second distance (D2), which is the distance between reinforcing elements (4) of the lower region (6) (D1<D2).

Another feature that can be appreciated in figure 9A is that A1=A2, wherein A is the sum of the areas Ai of the cross-section of all of the reinforcing elements (4) disposed at the same height of the tower in a vertical joint in each region (A1 for the upper region and A2 for the lower region), which depends on the number and the diameter of the reinforcing elements (4) (in this case it is supposed that the diameter of all the reinforcing elements (4) is the same). In this case, the number of reinforcing elements (4) at the same height of the tower in the

upper region (5) is the same than the number of reinforcing elements (4) at the same height of the tower in the lower region (6).

In figure 9B it is represented another embodiment of the invention. In this case, the first distance (D1), which is the distance between reinforcing elements (4) of the upper region (5), is equal than the second distance (D2), which is the distance between reinforcing elements (4) of the lower region (6) (D1=D2). In addition, in this embodiment, A1>A2, the number of reinforcing elements (4) at the same height of the tower in the upper region (5) is higher than the number of reinforcing elements (4) at the same height of the tower in the lower region (6). The diameter of all the reinforcing elements (4) is the same.

In figure 9C it is represented another embodiment of the invention. In this case, the first distance (D1), which is the distance between reinforcing elements (4) of the upper region (5), is smaller than the second distance (D2), which is the distance between reinforcing elements (4) of the lower region (6) (D1 <D2). In addition, in this embodiment, A1>A2, the number of reinforcing elements (4) at the same height of the tower in the upper region (5) is higher than the number of reinforcing elements (4) at the same height of the tower in the lower region (6). The diameter of all the reinforcing elements (4) is the same.

According to said figures 9A-C, different embodiments of the invention are described. Different configurations of the wind turbine tower can be used to reach the minimum shear resistance depending on the estimated values of expected shear force. The embodiments depicted in figures 9A -C are different options and the selection of one of them among the others could be made, for example, according to the available space for the reinforcing element (4) in the corresponding section of the wind turbine tower.

Exemplary, when it has been calculated the amount of material, preferably steel, needed for reinforcing the vertical joints of the wind turbine tower, said amount of material can be disposed in different ways in the vertical joints. In the present invention this is achieved by means of the reinforcing elements (4).

In figure 10 has been represented a wind turbine tower with reinforcing elements (4) comprising a plurality of sections (a first section, a second section, a third section, a fourth section, a fifth section and a sixth section). It would be the same cases as in figures 9A-C . In one embodiment of the invention, the distance between reinforcing elements (4) of each section is smaller than the distance between reinforcing elements (4) of the subsequent sections (D1<D2<D3<D4<D5<D6) and (A1=A2=A3=A4=A5=A6).

In another embodiment of the invention, the distance between reinforcing elements (4) of each section is equal to the distance between reinforcing elements (4) of the subsequent sections (D1=D2=D3=D4=D5=D6) and (A1>A2>A3>A4>A5>A6).

In a further embodiment of the invention, the distance between reinforcing elements (4) of each section is smaller than the distance between reinforcing elements (4) of the subsequent sections (D1<D2<D3<D4<D5<D6) and (A1>A2>A3>A4>A5>A6).

In figure 11 it has been represented a wind turbine tower with reinforcing elements (4) wherein the values of the distance between reinforcing elements (4) and the values of A (dependent on the number of reinforcing elements disposed at the same height of the tower and the cross-section of the reinforcing elements) depend on the height of the tower. On this basis, in a fourth embodiment of the invention, the distance between reinforcing elements (4) follows a function dependent on the height at which the reinforcing element is located. The distance can be different between each pair of reinforcing elements (4) along the tower, increased in a continuous manner from top to bottom). That is to say, the separation between the reinforcing elements is crescent in a continuous manner between the upper region and the lower region.

In a fifth embodiment, the cross section of the reinforcing elements (4) follows a function dependent on the height at which the reinforcing element (4) is located.

Preferably, the reinforcing elements (4) are disposed perpendicular to the vertical joints (3), as shown in the figures, and they are preferably selected between a bolt or a rebar. When the reinforcing elements (4) are bolts, they are preferably curved bolts as can be seen in figure 12. On the other hand, when the reinforcing elements (4) are rebars, they are preferably partially embedded in the at least two segments (2), as depicted in figure 13 . As it can be seen in figures 12 and 13 , the reinforcing elements (4) are disposed transversely to the vertical joints (3) and extending at least partially through the at least two segments (2). Additionally, in an embodiment of the invention, the reinforcing elements (4) are configured to connect the segments (2) between them.

Also, the tower can be at least partially made of concrete.

CLAIMS

1.- Wind turbine tower with reinforcing elements comprising:

- at least a first section (1) comprising at least two segments (2) defining at least two vertical joints (3) disposed between the at least two segments (2),

- at least two reinforcing elements (4) placed in each vertical joint (3),

- at least an upper region (5) disposed above at least a lower region (6) of the wind turbine tower characterized in that the reinforcing elements (4) are configured to provide a first shear strength (1ss) in the at least upper region, and a second shear strength (2ss) in the at least lower region (6), the first shear strength and the second shear strength having different values and being enough to bear a maximum expected shear force in the vertical joints (3)

2.- Wind turbine tower with reinforcing elements according to claim 1 characterized in that the first shear strength (1ss) is greater than the second shear strength (2ss).

3.- Wind turbine tower with reinforcing elements according to any of the previous claims characterized in that the vertical joints (3) in the at least one of the upper region (5) and/or the lower region (6) comprise more than one reinforcing element (4).

4.- Wind turbine tower with reinforcing elements according to any of the previous claims characterized in that the number of reinforcing elements (4) per meter in the at least upper region (5) is higher than the number of reinforcing elements (4) per meter in the at least lower region (6).

5.- Wind turbine tower with reinforcing elements according to any of the previous claims characterized in that there are at least two reinforcing elements (4) in the upper region (5) and at least two reinforcing elements (4) in the lower region (6) and a first distance (D1) along the height of the tower between reinforcing elements (4) of the upper region (5) is smaller than a second distance (D2) between reinforcing elements (4) of the lower region (6).

6.- Wind turbine tower with reinforcing elements according to any one of claims 1-4 characterized in that there are at least two reinforcing elements (4) in the upper region (5) and at least two reinforcing elements (4) in the lower region, and a first distance (D1) along the height of the tower between reinforcing elements (4) of the upper region (5) is greater than a second distance (D2) between reinforcing elements (4) of the lower region (6).

Dated this __ day of _____

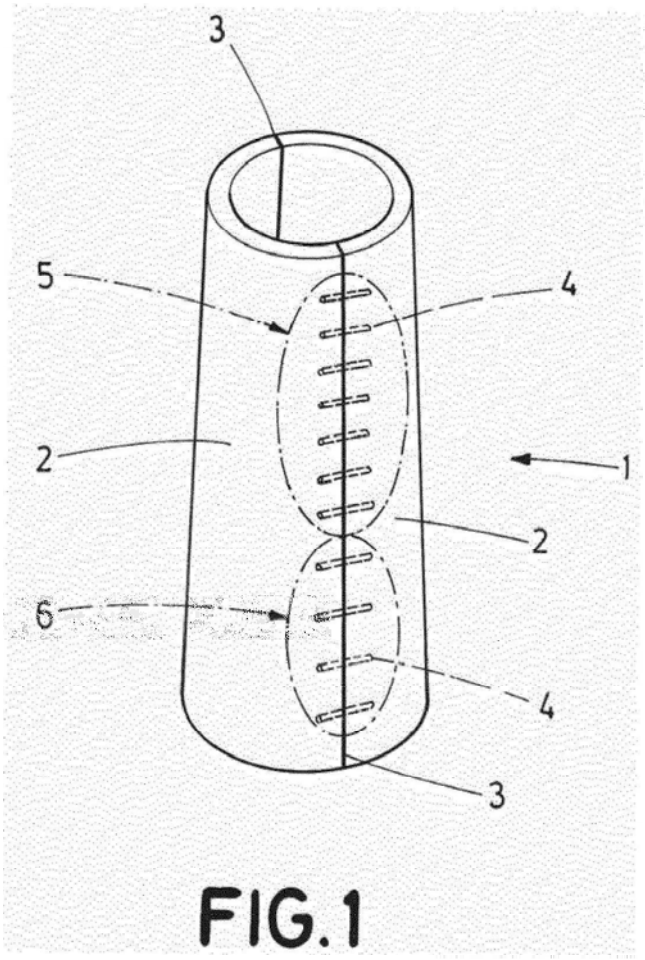


FIG.1

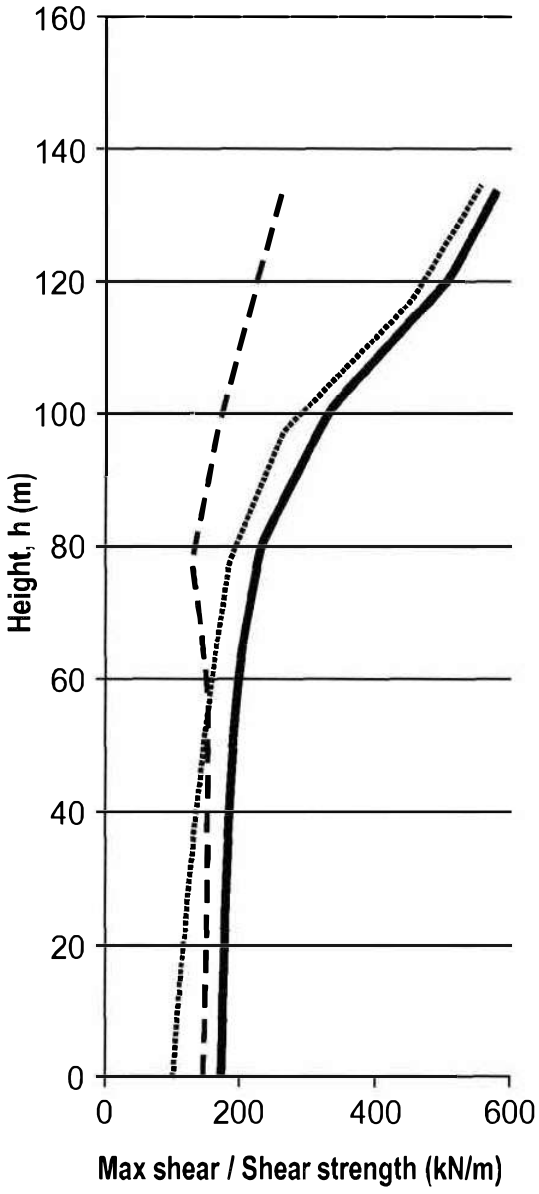

160
140
120
100
80
60
40
20
0
Height, h (m)
0
200
400
600
Max shear / Shear strength (kN/m)

FIG.2

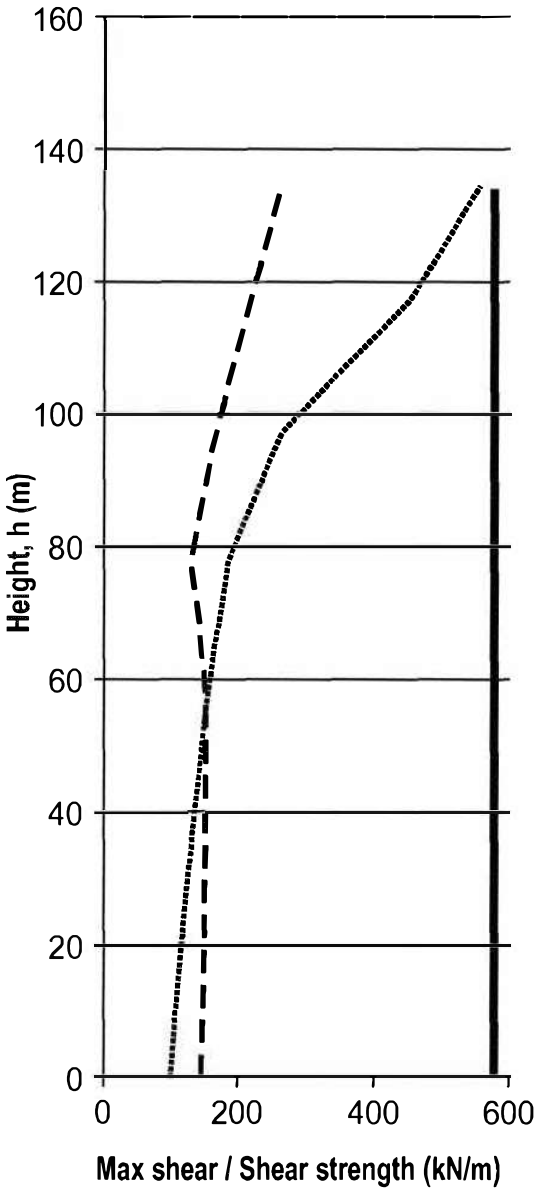

160
140
120
100
80
60
40
20
0
Height, h (m)
0
200
400
600
Max shear / Shear strength (kN/m)

FIG.3

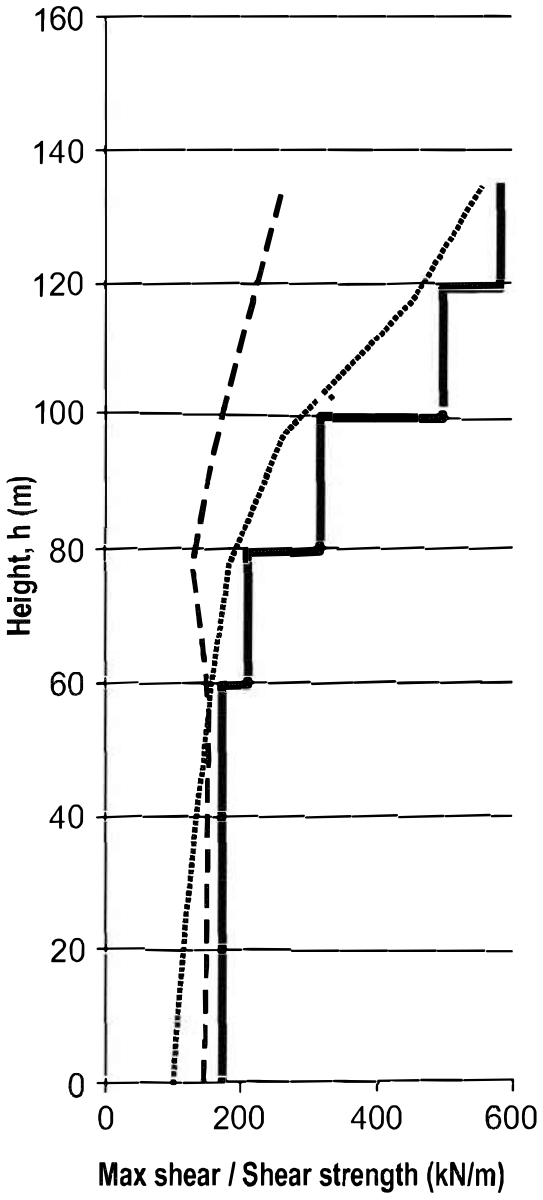

160
140
120
100
80
60
40
20
0
Height, h (m)
0
200
400
600
Max shear / Shear strength (kN/m)

FIG.4

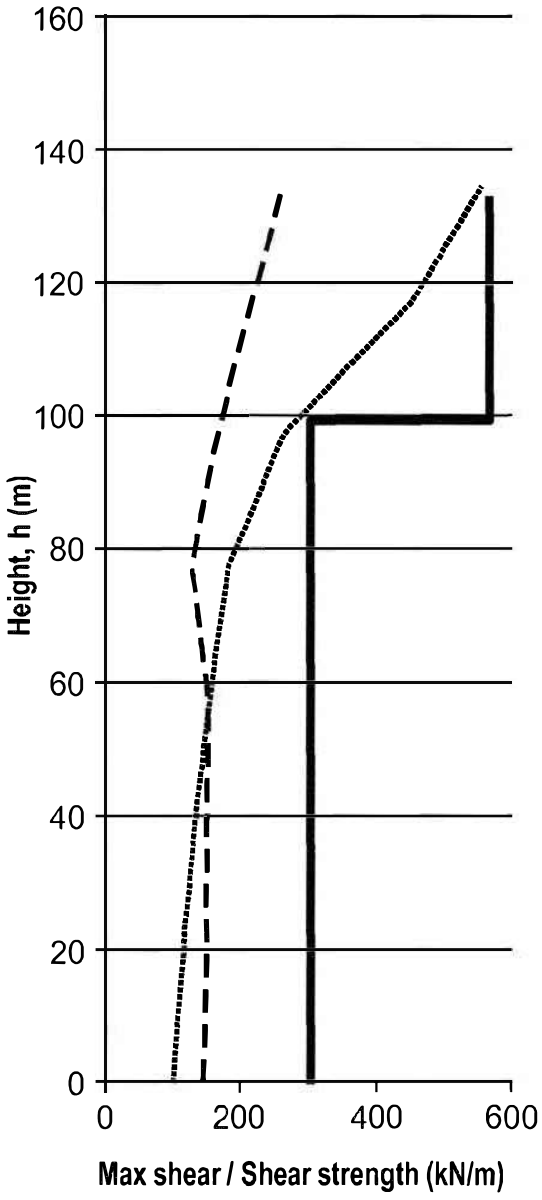

160
140
120
100
80
60
40
20
0
Height, h (m)
0
200
400
600
Max shear / Shear strength (kN/m)

FIG.5

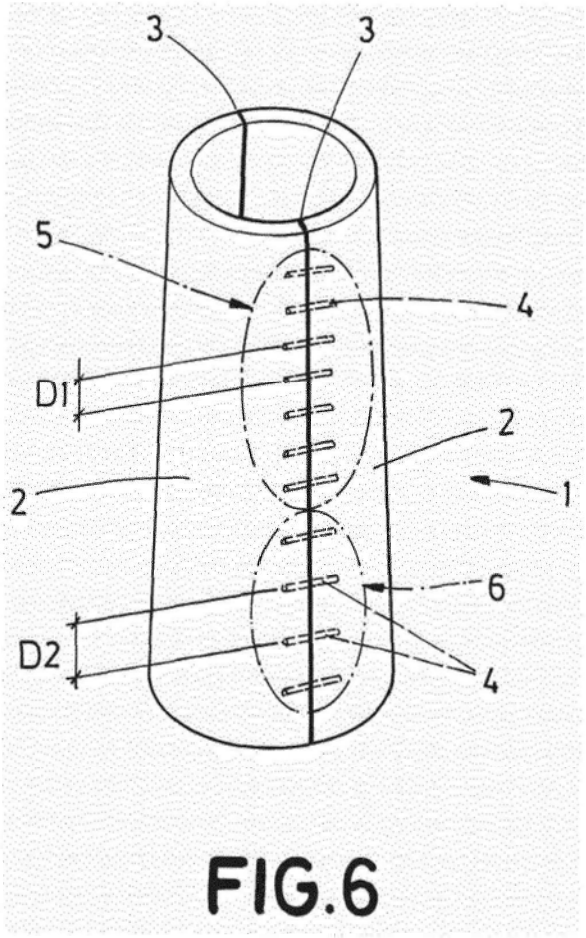


FIG.6

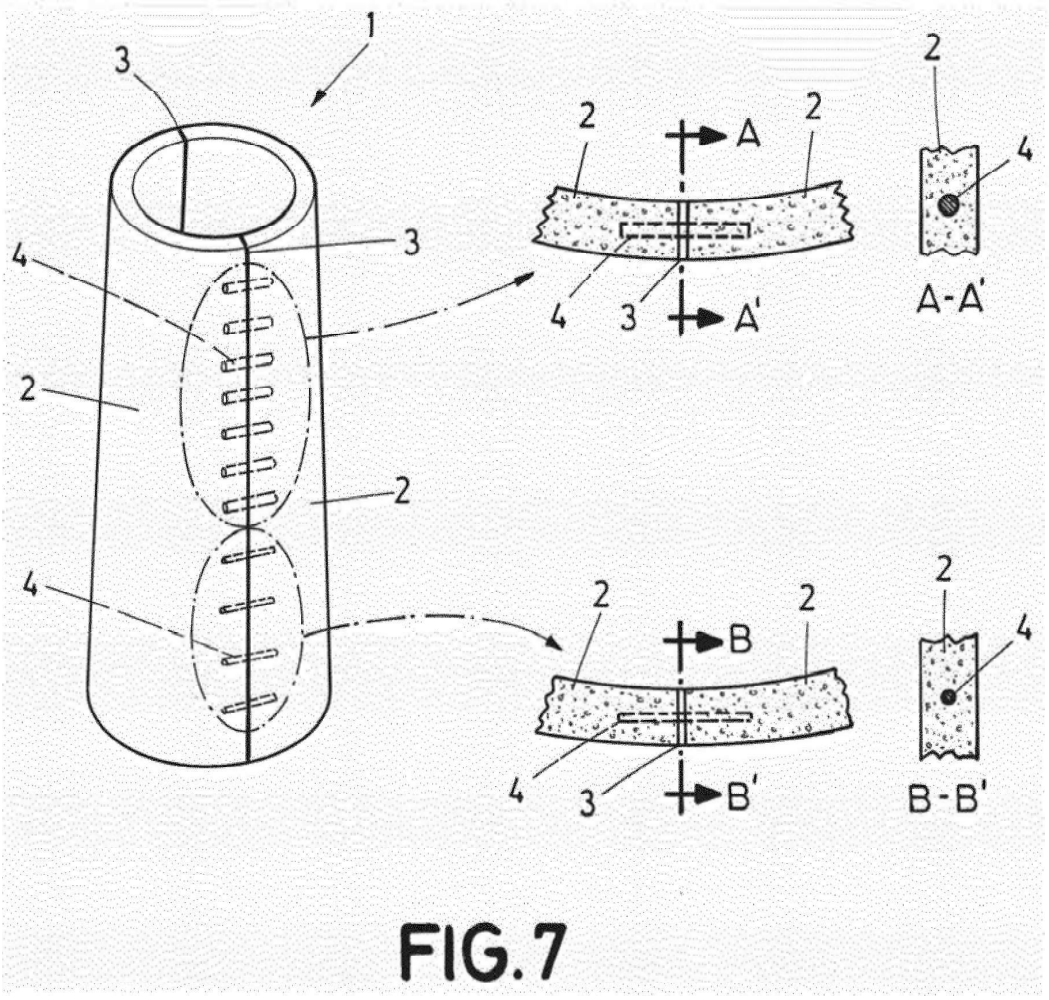


FIG.7

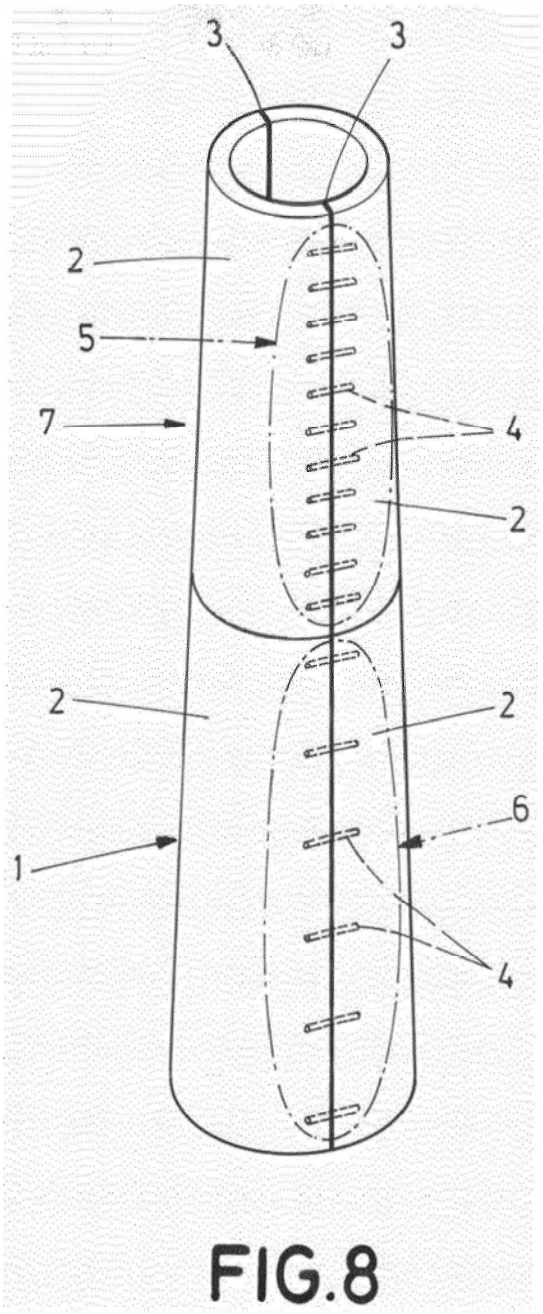
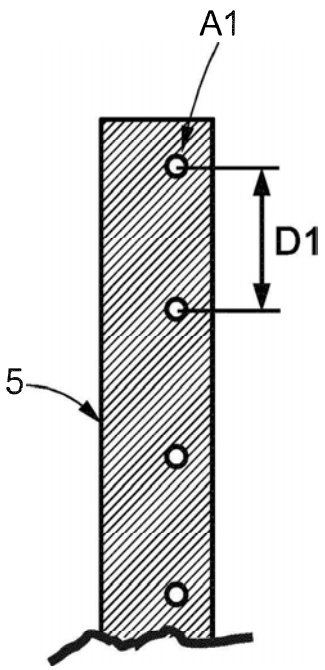
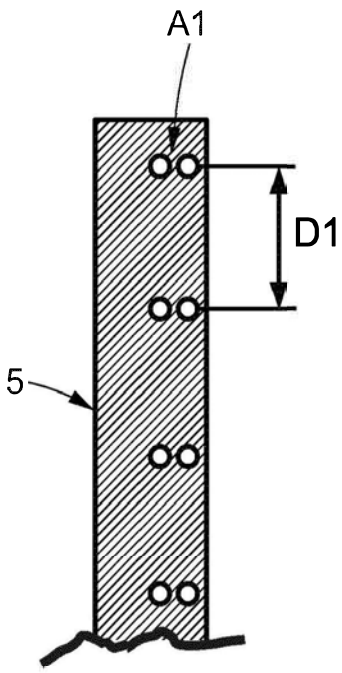
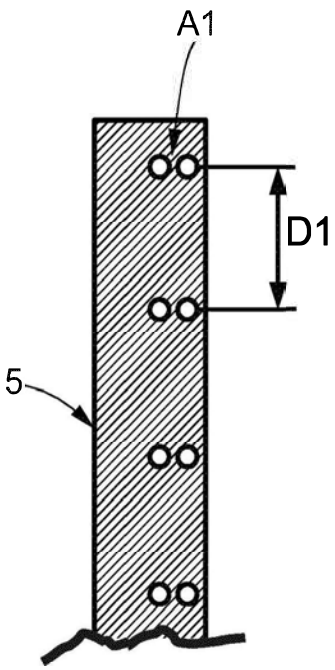
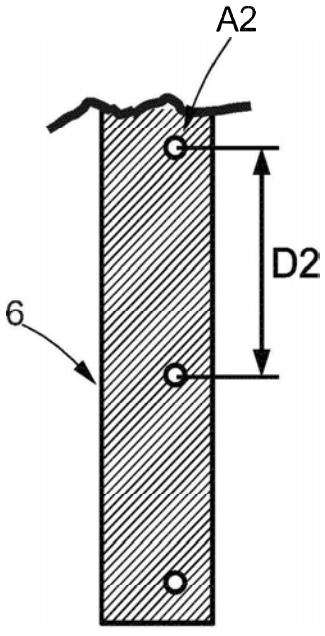


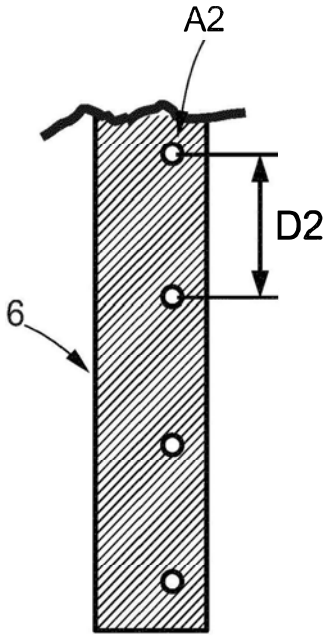
FIG.8

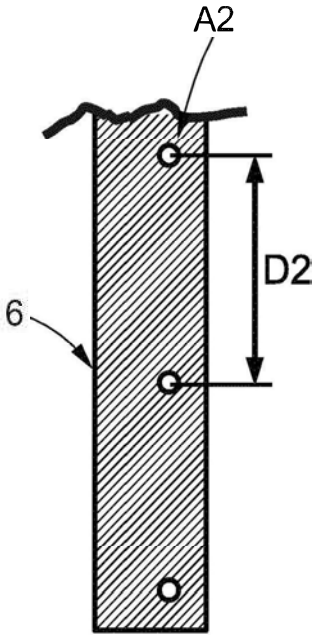












D1<D2
A1=A2

FIG.9A

D1=D2
A1>A2

FIG.9B

D1<D2
A1>A2

FIG.9C

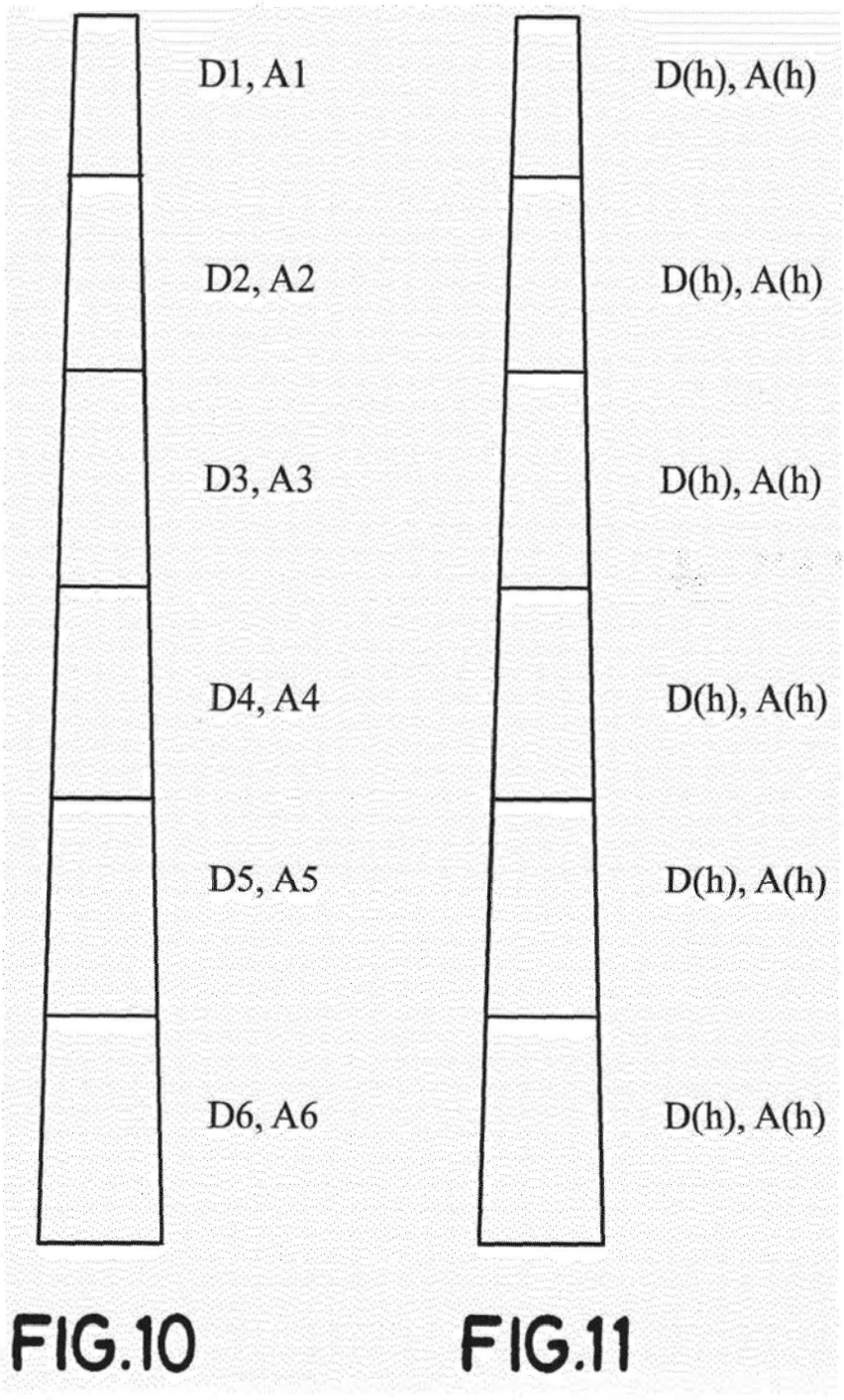


FIG.10 FIG.11

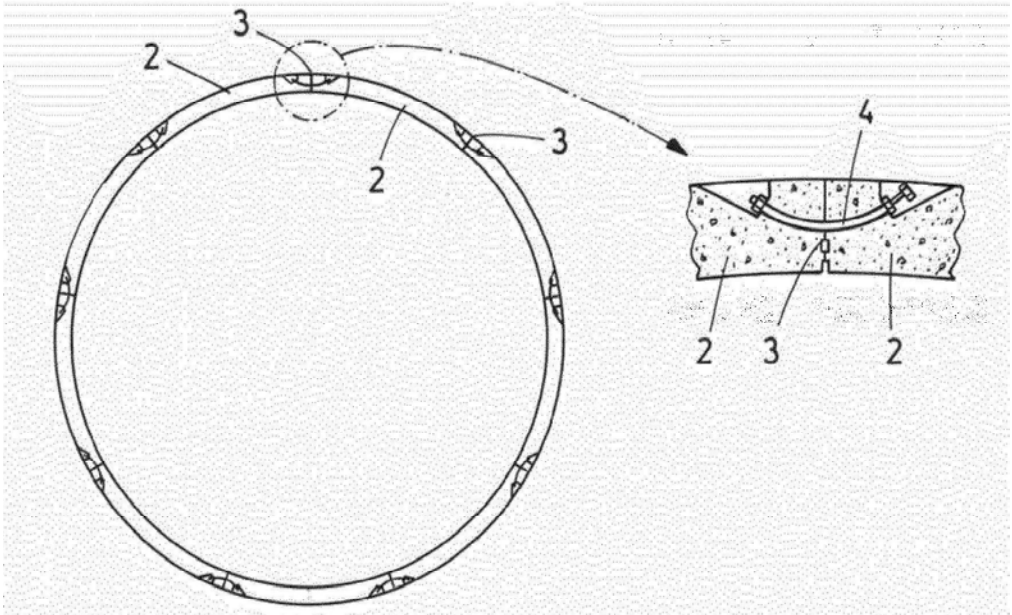


FIG.12

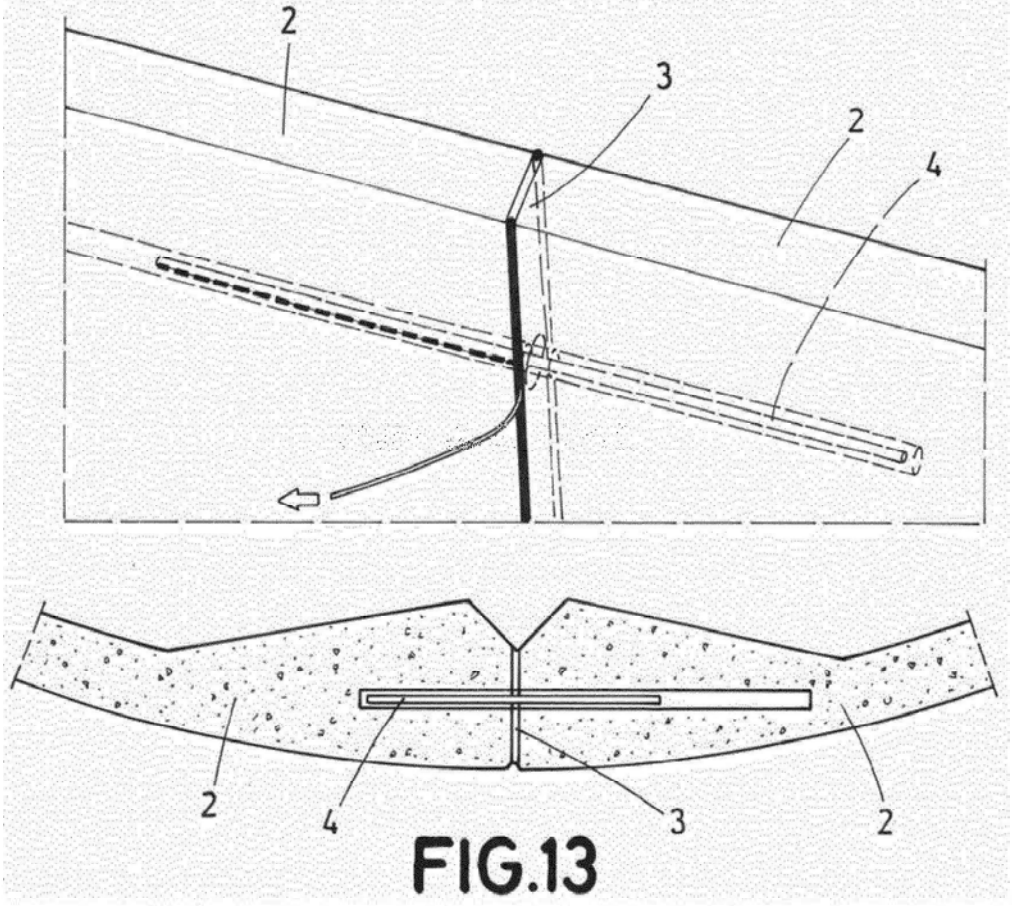


FIG.13

Annexure B

Allowed claims of European Patent Application No 17 380 003.3

1. Wind turbine tower with reinforcing elements comprising:
   - at least a first section (1) comprising at least two segments (2) defining at least two vertical joints (3) disposed between the at least two segments (2),
   - at least two reinforcing elements (4) placed in each vertical joint (3),
   - at least an upper region (5) disposed above at least a lower region (6), the wind turbine tower **characterized in that** the reinforcing elements (4) are configured to provide a first shear strength (1ss) in the at least upper region (5) and a second shear strength (2ss) in the at least lower region, (6) the first shear strength (1ss) and the second shear strength (2ss) having different values and wherein a relationship between the upper region (5) and the lower region (6) is selected from at least one attribute in the group consisting of:
     - a number of the reinforcing elements per meter in the at least upper region is higher than a number of the reinforcing elements per meter in the at least lower region;
     - at least two of the reinforcing elements (4) are in the upper region (5) and at least two of the reinforcing elements (4) are in the lower region (6) and a first distance (D1) along a height of the tower between the reinforcing elements (4) of the upper region (5) is smaller than a second distance (D2) between the reinforcing elements (4) of the lower region (6);
     - at least two of the reinforcing elements (4) are in the upper region (5) and at least two of the reinforcing elements (4) are in the lower region (6) and a first distance (D1) along the height of the tower between the reinforcing elements (4) of the upper region (5) is greater than a second distance (D2) between the reinforcing elements (4) of the lower region (6);
     - a cross-section of the reinforcing elements (4) of the upper region (5) is bigger than the cross-section of the reinforcing elements (4) of the lower region (6).

2. Wind turbine tower with reinforcing elements according to claim 1 **characterized in that** the first shear strength (1ss) is greater than the second shear strength (2ss).

3. Wind turbine tower with reinforcing elements according to any of the previous claims **characterized in that** the vertical joints (3) in the at least one of the upper region (5) and/or the lower region (6) comprise more than one reinforcing element (4).

Annexure C

The examination is being carried out on the following application documents

Description, Pages

1-15 as originally filed

Claims, Numbers

1-15 as originally filed

Drawings, Sheets

1-15 as originally filed

1. References is made to the following documents; the numbering will be adhered to in the rest of the procedure:

   D1 : WO 2017/046624 A1

2. The application does not meet the requirements of Article 84 EPC, because claim 1 is not clear.

2.1 The wording "*are configured to provide a first shear strength (1 ss) in the at least upper region (5) and a second shear strength (2ss) in the at least lower region (6), the first shear strength and the second shear strength having different values and being enough to bear a maximum expected shear force in the vertical joints (3)*" used in claim 1 is respectfully considered not sufficiently specific to clearly distinguish the claimed subject-matter from the prior art. In particular, it remains unclear what is referred to with the term "shear strength" which is different in one region with respect to another. Indeed, as the section of turbine tower usually changes with the height, the strength usually changes as well. In addition, as the wind speed varies with the height, the shear induced in the tower because of the wind force will also vary with the height. In addition, regarding the statement "to bear a maximum expected shear force in the vertical joints (3)", it is respectfully considered implicit that a tower segment is designed to bear a maximum expected shear force as it is a standard design procedure to produce tower's segments of this type.

Hence, the reader is left in doubt as to the meaning of the technical feature to which said wording refers, thereby rendering the definition of the subject matter of said claim unclear (Article 84 EPC).

3. Furthermore, notwithstanding the above-mentioned lack of clarity, the subject matter of claim 1 is not new within the meaning of Article 54(1) and (2) EPC, and the requirements of Article 52(1) EPC are therefore not met.

3.1 The document W02017046624 discloses (the references in parentheses applying to this document):

a wind turbine tower with reinforcing elements comprising:

- at least a first section (visible in Fig. 1 & 2c) comprising at least two segments (8 and 10; also visible in Fig. 2) defining at least two vertical joints (visible in fig. 2a-2c) disposed between the at least two segments,

- at least two reinforcing elements (24,24H,18,22) placed in each vertical joint,

- at least an upper region (the upper part of element shown in Fig. 3) disposed above at least a lower region (the tower part of element shown in Fig. 3) the wind turbine tower

whereby

the reinforcing elements (24,24H,18,22) are configured to provide a first shear strength (1 ss) in the at least upper region and a second shear strength (2ss) in the at least lower region, the first shear strength and the second shear strength having different values and being enough to bear a maximum expected shear force in the vertical joints (as mentioned in S 2 of the present communication, the shear strength of the tower section varies with the height. As a result, it will be different in the upper and lower arts. Moreover, the element has been designed to bear a maximum expected shear in the vertical joint, otherwise the tower structure would not serve its purpose [see e.g. p. 2, l.19-27]).

The subject-matter of claim 1 is therefore not new (Article 54(1) and (2) EPC).

4. With respect to the dependent claims the applicant is invited to take into account the following remarks.

4.1 Dependent claims 2-3 are not novel (Article 54(1) and (2) EPC) with respect to the disclosure of D1 (page 4, line 15 - page 11, line 28; figures).

5. The combination of the features of dependent claims 4-6 is neither known from, nor rendered obvious by, the available prior art. A new independent claim may be drafted to include these features, bearing in mind that the features known in combination in the prior art should be placed in the preamble of such a claim in accordance with Rule 43(1) EPC.

5.1 It is noted that this suggestion is only for assisting the applicant in his decision on how to proceed. It in no way precludes consideration of alternative solutions submitted by the applicant. The responsibility for determining the text of the application (Article 113(2) EPC) and in particular for defining the subject-matter for which protection is sought remains with the applicant.

6. To meet the requirements of Rule 42(1)(b) EPC, document D1 should be identified in the description and its relevant contents should be indicated. The applicant should ensure that it is clear from the

description which features of the subject-matter of the independent(s) claim(s) are known from the prior art.

7. The applicant is invited to file new claims which take account of the above comments.

7.1 When filing amended claims the applicant should at the same time bring the description into conformity with the amended claims. Care should be taken during revision, especially of the introductory portion and any statements of problem or advantage, not to add subject-matter which extends beyond the content of the application as originally filed (Article 123(2) EPC).

In order to facilitate the examination of the conformity of the amended application with the requirements of Article 1 23(2) EPC, the applicant should clearly identify the amendments carried out, irrespective of whether they concern amendments by addition, replacement or deletion, and to indicate the passages of the application as filed on which these amendments are based (see Guidelines H-III, 2.2).

Annexure D

(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
23 March 2017 (23.03.2017)

WIPO | PCT

(10) International Publication Number
WO 2017/046624 A1

(51) International Patent Classification:
E04B 1/04 (2006.01) *F03B 11/04* (2006.01)
E04H 12/12 (2006.01)

(21) International Application Number:
PCT/IB2015/001970

(22) International Filing Date:
17 September 2015 (17.09.2015)

(25) Filing Language: English

(26) Publication Language: English

(71) Applicant: **SOLETANCHE FREYSSINET** [FR/FR]; 280 avenue Napoléon Bonaparte, F-92500 Rueil Malmaison (FR).

(72) Inventors: **MELEN, Benoît**; 53 rue Jean Jaures, F-92270 Bois Colombes (FR). **FABRY, Nicolas**; 1 rue Galipeau, F-92160 Antony (FR).

(74) Agent: **CABINET PLASSERAUD**; 66, rue de la Chaussée d'Antin, 75440 Paris Cedex 09 (FR).

(81) Designated States *(unless otherwise indicated, for every kind of national protection available)*: AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IR, IS, JP, KE, KG, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) Designated States *(unless otherwise indicated, for every kind of regional protection available)*: ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, ST, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, KM, ML, MR, NE, SN, TD, TG).

Published:

— *with international search report (Art. 21(3))*

WO 2017/046624 A1

(54) Title: CIRCUMFERENTIAL SEGMENT OF A CONCRETE RING FOR FORMING A SUPPORT MAST

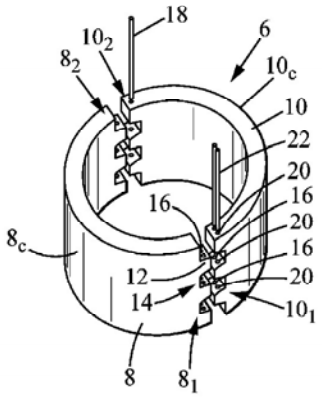


FIG. 2a

(57) Abstract: Circumferential segment of a concrete ring for forming a support mast A circumferential segment of a concrete ring for forming a mast comprising a plurality of superimposed concrete rings (6), said segment (8, 10) comprising a circumferential end (8_1, 10_1) destined to cooperate with a circumferential end (8_1, 10_1) of complementary shape belonging to another segment (8, 10) of said concrete ring (6) to form a circumferential joint of said concrete ring, said circumferential end comprising at least one first reception port (16) for receiving a first shear pin (18) configured to take up at least shear efforts applied to said circumferential joint. Corresponding concrete ring, support mast and manufacturing method.

Circumferential segment of a concrete ring for forming a support mast

The invention relates to the manufacturing of support masts, such as masts used to support wind turbine nacelles.

A typical design of such masts revolves around superimposing concrete rings to a desired height, for instance greater than 100 m.

Given the strains the mast is subjected to, the elementary rings used to form the mast are of sizeable dimensions.

A commonly used approach to manufacture these rings consists in cast-molding the rings in one piece, which results in rings offering good mechanical properties.

However, this approach also has drawbacks: the obtained rings are bulky and must be handled with extreme care in order to prevent their deterioration. These considerations result in these rings being inadequate for transportation, and therefore usually have to be manufactured on the mast construction site.

In order to address these problems, alternative approaches have been envisaged.

Some of them lie in manufacturing the rings by re-assembling initial circumferential segments which have been parted from one another.

A major concern in these approaches revolves around obtaining assembled rings which exhibit mechanical properties identical to those obtained through the previous approach, in particular around the joints which are formed when the different segments of the rings are assembled together.

To that end, the current state-of-the art techniques used to form the joints between different segments of a given ring consist in forming a concrete keying joint between the two segments, which, once hardened, provides a good mechanical resistance to efforts applied to the joint, such as shearing efforts that tend to part the segments from one another.

However, these techniques also present drawbacks. In fact, the time required for the drying of the concrete of the keying joint is long, which negatively impacts the amount of time required to build the support mast, all the more so as the mast may comprise a great number of superimposed rings.

The invention therefore seeks to improve the situation.

To that end, the invention relates to a circumferential segment of a concrete ring for forming a mast comprising a plurality of superimposed concrete rings, said segment comprising a circumferential end destined to cooperate with a circumferential end of complementary shape belonging to another

segment of said concrete ring to form a circumferential joint of said concrete ring, said circumferential end comprising at least one first reception port for receiving a first shear pin configured to take up at least shear efforts applied to said circumferential joint.

According to an aspect of the invention, the circumferential end further comprises at least one second reception port for receiving a second shear pin configured to take up at least shear efforts applied to said circumferential joint.

According to an aspect of the invention, at least one first reception port stretches along a direction contained in a circumferential section plane of said segment, said direction being parallel to a tangential plane to said segment in said circumferential section plane.

According to an aspect of the invention, the circumferential end comprises an alternation of tenons and mortises, the circumferential end comprising a plurality of first receiving ports for receiving said shear pin, said first reception ports being arranged in said tenons and being aligned with one another.

According to an aspect of the invention, the tenons comprise side faces which are horizontally bowed with respect to the circumference of said segment.

According to an aspect of the invention, the side faces of said tenons are horizontally bowed with respect to the circumference of said segment with an angle equal to or inferior to 10°.

According to an aspect of the invention, the segment further comprises at least one reinforcement bar having a portion which surrounds said first reception port.

The invention further relates to a concrete ring for forming a mast comprising a plurality of superimposed concrete rings, said concrete ring comprising at least a first circumferential segment and a second circumferential segment as defined above, the respective circumferential ends of the first, respectively the second circumferential segments being of complementary shape and cooperating with one another to define a circumferential joint of said concrete ring, the at least one first reception port of the circumferential end of the first circumferential segment being aligned with the at least one first reception ports of the circumferential end of the second circumferential segment, said concrete ring further comprising a first shear pin inserted in the first reception ports of said circumferential ends of first and second circumferential segments and being arranged to take up at least shear efforts applied to said circumferential joint.

According to an aspect of the invention, the circumferential ends of the first and second circumferential segments further comprise each at least one second reception port, the second reception ports of the circumferential ends of the first and second circumferential segments being aligned with one another, the concrete ring further comprising at least one second shear pin received in

the second reception ports of the circumferential ends of the first and second circumferential segments and arranged to take up at least shear efforts applied to said circumferential joint.

According to an aspect of the invention, the first and second reception ports are spaced apart radially.

According to an aspect of the invention, the first and second reception ports are spaced apart circumferentially.

According to an aspect of the invention, the first shear pin is sealed inside said first reception ports.

The invention further relates to a support mast for supporting a wind turbine, said support mast comprising a plurality of superimposed concrete rings, the support mast comprising at least one concrete ring as defined above.

The invention further relates to a method of manufacturing a concrete ring as defined above, said method comprising:

- obtaining a first circumferential segment and a second segment circumferential each having a circumferential end having a shape complementary of that of the circumferential end of the other circumferential segment, said circumferential ends each comprising at least one first reception port,

- arranging the circumferential ends in contact in one another to form a circumferential joint of the concrete ring and so that the first reception ports of the circumferential ends of the first and second circumferential segments are aligned, and

- inserting a shear pin in the first reception ports of the circumferential ends of the first and second circumferential segments to take up at least shear efforts applied to said circumferential joint.

According to an aspect of the invention, the method further comprises sealing the shear pin inside the first reception ports.

According to an aspect of the invention, the method further comprises sealing the first and second circumferential ends together.

According to an aspect of the invention, the method further comprising manufacturing the first and second circumferential segments using a cast and a separation element arranged in said cast to define the respective circumferential ends of the first and second circumferential segments.

According to an aspect of the invention, manufacturing the first and second circumferential segments comprises :

- arranging one or more rods inside the cast and through holes of the separation element to form the first reception ports,

- pouring concrete in the cast,

- removing the one or more rods after the poured concrete has hardened.

According to an aspect of the invention, the one or more rods comprise said first shear pin.

Further features and advantages of the invention will become more apparent by reading the following detailed description of the embodiments, which are given by way of non-limiting examples with reference to the appended drawings, in which:

- Figure 1 illustrates a support mast according to the invention;

- Figures 2a, 2b and 2c illustrate a concrete ring according to the invention;

- Figure 3 illustrates a sectional view of a circumferential end of a circumferential segment of a concrete ring according to the invention;

- Figure 4 illustrates a manufacturing process of a concrete ring and of a support mast according to the invention;

- Figure 5 illustrates a cast and a separation element used during the process of Figure 4; and

- Figure 6 illustrates a concrete ring according to an alternative embodiment of the invention.

Figure 1 illustrates a support mast 2 according to the invention.

The support mast 2 is for instance destined to support a wind turbine nacelle 4.

The support mast 2, or mast 2, comprises a plurality of superimposed rings 6. At least one of the rings 6 is a ring according to the invention.

In reference to Figures 2a to 2c, a ring 6 according to the invention presents an annular shape.

More precisely, the ring 6 presents a cylindrical shape stretching circumferentially around a central axis X (Figure 2b).

For instance, the ring 6 has a straight cylindrical shape. In other words, his surface is generated by a line which is parallel to the central axis X.

Alternatively, the ring 6 may have a frustoconical cylindrical shape. In other words, the surface of the ring is generated by a line which is not parallel to the central axis.

Advantageously, the ring 6 is made of concrete, and preferably of reinforced concrete. This is further detailed below.

In further reference to Figures 2a to 2c, the ring 6 comprises at least two separate circumferential segments 8, 10.

These segments 8, 10 each form a portion of the circumference of the ring 6. The segments make-up the ring once assembled together.

The ring 6 may solely comprise two segments, as in Figures 2a to 2c, or more than two segments.

In the example of the Figures, the ring 6 comprises a first circumferential segment 8, hereafter first segment 8, and a second circumferential segment 10, hereafter second segment 10.

The first and second segment 8, 10 each comprise a first circumferential end 8_1, 10_1 respectively, hereafter first end 8_1, 10_1.

The first ends 8_1, 10_1 are destined to be coupled to one another in a coupled configuration to form a circumferential joint J (Figure 1 and 2c) of the ring 6. To that end, the first ends 8_1, 10_1 are of complementary shape.

For instance, each first end 8_1, 10_1 comprises at least one tenon 12 and one mortise 14 destined to cooperate with a complementary mortise 14 and tenon 12 of the first end of the other segment.

Advantageously, each first end 8_1, 10_1 comprises alternation of tenons 12 and mortises 14 destined to cooperate with complementary mortises 14 and tenons 12 present on the other first end 8_1, 10_1.

Advantageously, this alternation of tenons and mortises runs along the entire first end, i.e. from the top extremity of the first end to the bottom extremity of the first end (given the orientation of the Figures).

The tenons 12 and mortises 14 present themselves in the form of protrusions, respectively grooves extending circumferentially with respect to the central axis X. The tenons 12 extend circumferentially away from a central portion 8_C, 10_C of the corresponding segment 8, 10, whereas the mortises 14 extend circumferentially towards this central portion 8_C, 10_C.

In the coupled configuration, the tenons of a given first end 8, 10 are engaged in the mortises of the other first end and are in abutment in the latter.

In reference to Figure 3, the tenons 12 comprise side faces 12F which are oriented along the generation line of the corresponding segment, i.e. toward the top or the bottom of Figure 3. The side faces 12F are further horizontally bowed with respect to the circumference of the corresponding segment 8, 10. In view of the orientation of Figure 3, the side faces 12F are thus bowed relative to a horizontal plane.

Preferably, the bowing angle α of the side faces 12F is inferior to or equal to 10°. Advantageously, this angle α is inferior or equal to 5°, and is for instance comprised in the range [3°; 5°].

Given the complementary shape of the first ends 8_1, 10_1 and given that the side faces 12F of the tenons also correspond to the side faces of the neighboring mortises, the mortises themselves present side faces which are bowed with respect to the circumference of the segment 8, 10.

In the context of the invention, the segments 8, 10 further comprise at least one first reception port 16 for receiving a shear pin 18 configured to take up at least shear efforts applied to the joint J formed by the first ends 8_1, 10_1.

The first reception ports 16 are arranged in the first end 8_1, 10_1 of the corresponding segment 8, 10.

In the example of Figures 2a to 2c, each first end 8_1, 10_1 comprises, for at least one tenon 12, a first reception port 16 which traverses the tenon 12 from one side face 12F to the opposite side face 12F.

Advantageously, the first end 8_1, 10_1 comprises, for each tenon 12, a first reception port 16 which traverses the tenon 12 from one side face 12F to the opposite side face 12F.

The first reception ports 16 of a given first end 8_1, 10_1 are aligned with one another. Moreover, the first reception ports 16 are arranged so that when the first ends 8_1, 10_1 of the segments 8, 10 are in coupled configuration, the first reception ports 16 of the first ends of both segments 8, 10 are all aligned.

In reference to Figure 3, the first reception ports 16 present a straight cylindrical shape. The reception ports 16 are preferably through-holes.

Advantageously, they extend along a direction which is contained in a circumferential section plane of the corresponding segment 8, 10, i.e. a radial plane with respect to axis X. In this section plane, the direction of the reception ports 16 is parallel to the tangential plane of the segment.

In other words, the reception ports 16 are arranged in parallel to the generation line of the considered ring 6. For a straight cylindrical ring 6, the reception ports 16 thus extend vertically.

Advantageously, the segments 8, 10 further comprises second reception ports 20 for receiving a second shear pin 22 designed to take up at least shear efforts applied to the joint J (Figure 2a).

The second reception ports 20 present a configuration analogous to that of the first reception ports 16. In other words, for a given segment, they are located on the first end and are arranged to be aligned with one another on that first end. In addition, the complementary first end of the other segment destined to form the joint J along with the considered segment also comprises second reception ports 20 arranged to be aligned among each other. The second reception ports 20 of the first ends of the two segments are arranged to be aligned when the first ends are in the coupled configuration.

For a given first end 8_1, 10_1, the first and second reception ports 16 are spaced apart. They may be spaced apart radially relative to the central axis X. They may also or alternatively be spaced apart circumferentially around that axis X.

Advantageously, the second reception ports are located in the neighborhood of the first reception ports. For instance, they are also arranged in the tenons of the first end.

In reference to Figures 2a to 2c, the shear pins 18, 22 are destined to be inserted in the first reception ports 16 (and second reception ports 20 if any) to take up at least shear efforts applied to the joint J in which they are inserted. They thus form shear keys.

In particular, they are configured to take up shear efforts that tend to move the corresponding segments away from one another, and thus contribute to prevent a possible dislocation of the ring 6 around the joint J once the segments have been assembled.

The shear pins 18, 22 are for instance made of highly adherent steel.

They comprise a rod portion 18R which is to be inserted in the reception ports. The rod portion 18R presents dimensions roughly complementary of that of the corresponding reception port, in particular in terms of diameter.

Advantageously, the rod portion 18R presents a length which is adapted to have the rod portion in a flush configuration relative to the reception ports. In other words, once inserted in the reception port, the rod portion 18R is more or less entirely contained in the reception ports of the cooperating first ends of the considered segments and more or less entirely fills the reception ports. In other words, advantageously, the rod portion 18R is as high as the ring itself.

The rod portion 18R advantageously comprises a diameter between 10 and 40 mm.

The rod portion 18R advantageously presents a length comprises between 20 and 100 cm.

The shear pins 18, 22 may further comprise a handle portion 18H which protrudes from the segments, for instance above the segment.

In reference to Figure 3, the segments 8, 10 further comprise reinforcement bars 24 configured to enhance the mechanical properties of the segments.

These bars 24 are preferably arranged within the matter of the segment. The bars 24 are for instance made of steel.

The bars 24 include circumferential bars 24H which stretch along the circumference of the considered segment. The bars 24 further include bars 24V which are arranged perpendicularly to the

circumferential bars 24H. The bars 24V thus stretch in a direction parallel to the generation line of the considered segment. The bars 24H and 24V may be coupled together to enhance the distribution of the efforts they take up within the segment.

In the context of the invention, at least one reinforcement bar 24H comprises a portion 24S (Figure 3) which surrounds a first reception port 16 of the first end.

More specifically, the portion 24S presents a U-shape whose central portion is arranged between the corresponding reception port 16 and the extremity of the segment, and whose legs stretch towards the central portion of the segment.

The corresponding bar 24H for instance presents a first extended portion stretching in the matter of the segment, followed by the portion 24S which surrounds the reception port and which passes between the reception port and the extremity of the segment, itself followed by a second extended portion stretching parallel to the first extended portion and side-to-side with the latter. Alternatively, it may solely comprise the first extended portion and the portion 24S.

Preferably, the segment comprises, for each reception port, at least one reinforcement bar 24H which surrounds the considered reception port of the first end. For instance, it comprises two or more reinforcement bars 24H for every reception port 16.

In embodiments in which the segment comprises first and second reception ports, the reinforcement bar 24H advantageously also surrounds the neighboring second reception port.

The above description has been given to illustrate the configuration of a given joint J of the ring 6.

However, this configuration may also be implemented for every joint J of the ring which results from the assembling of the segments that are to make-up the ring once assembled together.

In other words, advantageously, the segments 8, 10 further comprises a second circumferential end 8_2, 10_2, or second end, 8_2, 10_2 opposite of the first end 8_1, 10_1 and which presents a configuration identical to that of the first end 8_1, 10_1. In other words, the second end 8_2, 10_2 is destined to cooperate with a circumferential end of complementary shape belonging to another segment of the ring, whether the other segment 8, 10 or another segment if the ring comprises more than two segments, in order to form another joint J.

The second end advantageously also comprises tenons and mortises as described above. It further comprises first reception ports 16 which are aligned to receive a shear pin 18, 22. These ports are preferably arranged in the tenons. Optionally, it further comprises second reception ports 20 which are also aligned and are arranged to receive a further shear pin. They are spaced apart radially and/or circumferentially from the first reception ports.

The segment also comprises at least one reinforcement bar which surrounds a first reception port of the second end in the manner described above, and preferably comprises such a reinforcement bar for every first reception port.

A method for manufacturing a ring according to the invention and for building a support mast according to the invention will now be described in reference to the Figures for an embodiment in which the ring only comprises two segments, the transposition to embodiments in which it comprises more than two segments being immediate.

During a first step S1, the segments 8, 10 of the ring are manufactured.

In reference to Figure 5, this step is carried using a cast 26 which defines an inner cavity having the general shape which is desired for the ring 6.

The cast 26 is for instance made of metal.

The cast 26 further comprises, for each joint J of the ring 6, a separation element 28 arranged in the cast to form the respective complementary shapes of the first ends 8_1, 10_1 of the two segments.

The separation element 28 presents itself in the form of a thin plate of desired shape and is arranged vertically in the cast. The thickness of the separation element 28 may be of a few millimeters or less.

In the example of Figure 5, the separation element 28 has a geometry configured to define the tenons and mortises of the first ends 8_1, 10_1.

The separation element 28 comprises holes 30 arranged to form, in conjunction with a rod 32, the first reception ports 16 once the cast has been filled and the poured material has hardened.

The holes 30 are aligned in the desired configuration (for instance vertically in the cast for a straight cylindrical ring, or in the configuration described above for a frustoconical ring).

Advantageously, the rod 32 corresponds to the shear pin 18, 22 destined to be received in the joint once the ring has been assembled. Alternatively, the rod 32 may be distinct from the shear pin.

If the segments are to comprise second reception ports, the separation element 28 comprises a corresponding number of holes arranged in the appropriate configuration.

Once the separation elements 28 have been arranged in the cast, the rod 32 in inserted in the cast through the separation element 18 via the holes 30.

The reinforcement bars 24 are also installed in the cast in the desired configuration, either sequentially with the separation element 28 or at the same time.

Concrete is then poured in the cast 26 and fills the latter. Once the concrete has hardened, the rod 32 is removed, thereby clearing the reception ports, and the newly formed segments are extracted from the cast.

They may then be moved to another site for assembling.

During a step S2, the segments of the ring obtained via step S1 are assembled together to form the ring 6.

To that end, the ends of the segments are arranged in abutment with the complementary ends of the other segments so as to form the general shape of the ring and are sealed in this configuration. In the example of Figures 2a to 2c, the first ends 8_1, 10_1 are pushed together so that the extremities of the tenons of one first end abut in the corresponding mortises of the other first end, and so are the second ends 8_2, 10_2.

For the sealing of the ends together, the ends are for instance coated with a glue or mortar prior to being pushed against one another. The glue is for instance epoxy glue. The mortar is for instance a liquid mortar.

For every end of every segment, the shear pins 18, 22 are then inserted in the corresponding reception ports 16, 20 which have thus been aligned. The shear pins 18, 22 are then sealed in the reception ports.

To that end, a mortar or a resin is poured in the reception ports once the shear pins have been inserted.

Once these tasks have been performed, the joints J of the ring are formed and the ring is assembled.

Once the ring 6 has been assembled, the ring 6 may be used to manufacture the support mast 2.

To that end, during a step S3, it is installed on top of the previously installed rings of the support mast 2.

If needed, for instance in embodiments in which the shear pins of the ring located on top of the pile of the previously installed rings comprise a handle portion 18H, this installation includes arranging grooves in the bottom surface of the ring to be installed in which the handle portions 18H of the ring below it may be received.

The invention presents many advantages.

In particular, it eases the transportation of the rings, as they are made of smaller segments, while negating the impact that the reassembling of the rings may have over their mechanical properties.

In addition, the use of mortises and tenons contributes favorably to these properties.

Having a plurality a shear pins further increases the mechanical properties of the joints J, in particular when under stresses which tend to part the segments radially.

Moreover, having reinforcement bars which surround the reception ports enhances the transmission of efforts applied to the shear pins to the rest of the segment.

Many modifications and variations of the present invention are made possible in the light of the above teachings. It is therefore to be understood that within the scope of the appended claims, the invention may be practiced otherwise than as specifically described.

In particular, in an alternative embodiment illustrated in Figure 6, the ends of the segment may present a shape other than that of an alternation of tenons and mortises.

For instance, the ends present a beveled shape.

In addition, in the description above, the reception ports 16, 20 have been described as being formed directly by the rods 32.

However, in some embodiments, in order to ease the removal of the segments from the cast, each reception port 16 contains a sheath 16S (Figure 3, in which a single sheath is represented) which forms a wall of the corresponding reception port.

Each sheath presents a shape identical to that of the hole it is arranged in. In other words, it presents the same height and its extremities are conformed to match the geometrical configuration of the opening of the port.

The sheaths present for instance a hollow cylindrical shape. In order to account for the geometrical configuration of the opening of the port which are for the most part located on the side faces 12F which may be beveled, one or both of its extremities may be beveled as well if the side faces 12F are.

In addition, it presents dimensions, in particular a diameter, complementary of that of the rods 32 and of the shear pin 18, 22 it is intended to receive. Thus, the efforts applied to the shear pin are more efficiently distributed over the concrete surrounding the reception port and against which the sheath is arranged.

For the manufacturing of the ring, for each joint J, the sheaths of the reception ports of both considered ends are inserted in the cast along with the rod(s) 32 prior to the concrete being poured.

Given the construction sequence of a given segment, the sheaths present by construction an external diameter complementary of that of the corresponding reception port.

CLAIMS

1. Circumferential segment of a concrete ring for forming a mast comprising a plurality of superimposed concrete rings (6), said segment (8, 10) comprising a circumferential end (8_1, 10_1) destined to cooperate with a circumferential end (8_1, 10_1) of complementary shape belonging to another segment (8, 10) of said concrete ring (6) to form a circumferential joint (J) of said concrete ring, said circumferential end comprising at least one first reception port (16) for receiving a first shear pin (18) configured to take up at least shear efforts applied to said circumferential joint.

2. Segment according to claim 1, wherein the circumferential end (8_1, 10_1) further comprises at least one second reception port (20) for receiving a second shear pin (22) configured to take up at least shear efforts applied to said circumferential joint.

3. Segment according to claim 1 or 2, wherein at least one first reception port (16) stretches along a direction contained in a circumferential section plane of said segment, said direction being parallel to a tangential plane to said segment in said circumferential section plane.

4. Segment according to any one of the preceding claims, wherein said circumferential end comprises an alternation of tenons (12) and mortises (14), the circumferential end comprising a plurality of first receiving ports (16) for receiving said shear pin, said first reception ports being arranged in said tenons (12) and being aligned with one another.

5. Segment according to claim 4, wherein said tenons comprise side faces (12F) which are horizontally bowed with respect to the circumference of said segment.

6. Segment according to claim 5, wherein the side faces (12F) of said tenons are horizontally bowed with respect to the circumference of said segment with an angle equal to or inferior to 10°.

7. Segment according to any one of claims 1 to 6, wherein said segment further comprises at least one reinforcement bar (24) having a portion (24S) which surrounds said first reception port.

8. A concrete ring for forming a mast comprising a plurality of superimposed concrete rings, said concrete ring (6) comprising at least a first circumferential segment (8) and a second circumferential segment (10) according to any one of claims 1 to 7, the respective circumferential ends (8_1, 10_1) of the first (8), respectively the second (10) circumferential segments being of complementary shape and cooperating with one another to define a circumferential joint (J) of said concrete ring, the at least one first reception port (16) of the circumferential end of the first circumferential segment (8) being aligned with the at least one first reception ports (16) of the circumferential end (10_1) of the second circumferential segment, said concrete ring further comprising a first shear pin (16) inserted in the first reception ports (16) of said circumferential ends of the first and second circumferential segments and being arranged to take up at least shear efforts applied to said circumferential joint.

9. A concrete ring according to claim 8, wherein the circumferential ends of the first and second circumferential segments further comprise each at least one second reception port (20), the second reception ports of the circumferential ends of the first and second circumferential segments being aligned with one another, the concrete ring further comprising at least one second shear pin (22) received in the second reception ports of the circumferential ends of the first and second circumferential segments and arranged to take up at least shear efforts applied to said circumferential joint.

10. A concrete ring according to claim 9, wherein the first and second reception ports are spaced apart radially.

11. A concrete ring according to claim 9 or 10, wherein the first and second reception ports are spaced apart circumferentially.

12. A concrete ring according to any of claims 8 to 11, wherein the first shear pin (18) is sealed inside said first reception ports.

13. A support mast for supporting a wind turbine, said support mast comprising a plurality of superimposed concrete rings, wherein the support mast comprises at least one concrete ring (6) according to any one of claims 8 to 12.

14. A method of manufacturing a concrete ring according to any of claims 8 to 12, said method comprising:

- obtaining a first circumferential segment (8) and a second segment circumferential (10) each having a circumferential end (8_1, 10_1) having a shape complementary of that of the circumferential end of the other circumferential segment (8, 10), said circumferential ends each comprising at least one first reception port (16),

- arranging the circumferential ends of the first and second circumferential segments in contact in one another to form a circumferential joint (J) of the concrete ring and so that the first reception ports (16) of the circumferential ends of the first and second circumferential segments are aligned, and

- inserting a first shear pin (16) in the first reception ports of the circumferential ends of the first and second circumferential segments to take up at least shear efforts applied to said circumferential joint.

15. The method of claim 14, the method further comprising sealing the shear pin (16) inside the first reception ports.

16. The method of claim 14 or 15, the method further comprising sealing the first and second circumferential ends (8_1, 10_1) together.

17. The method of any one of claims 14 to 16, the method further comprising manufacturing the first and second circumferential segments using a cast (26) and a separation element (28) arranged in said cast to define the respective circumferential ends of the first and second circumferential segments.

18. The method of claim 17, wherein manufacturing the first and second circumferential segments comprises :

- arranging one or more rods (32) inside the cast (26) and through holes (30) of the separation element to form the first reception ports,

- pouring concrete in the cast,

- removing the one or more rods (32) after the poured concrete has hardened.

19. The method according to claim 18, wherein the one or more rods (32) comprise said first shear pin (16).

FIG. 1

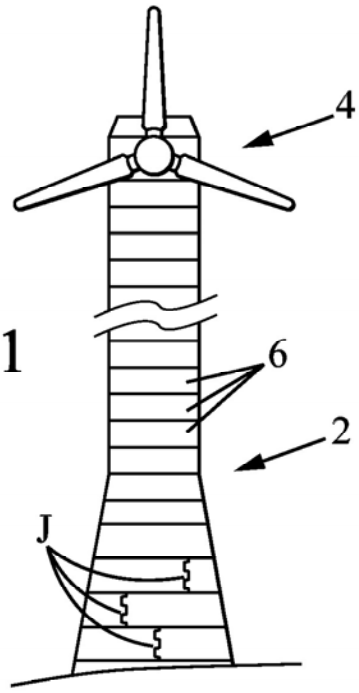
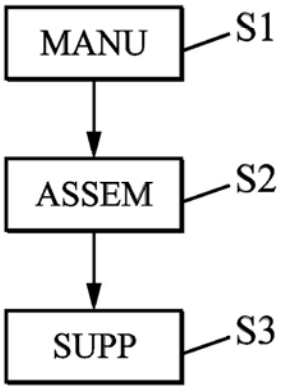


FIG. 4



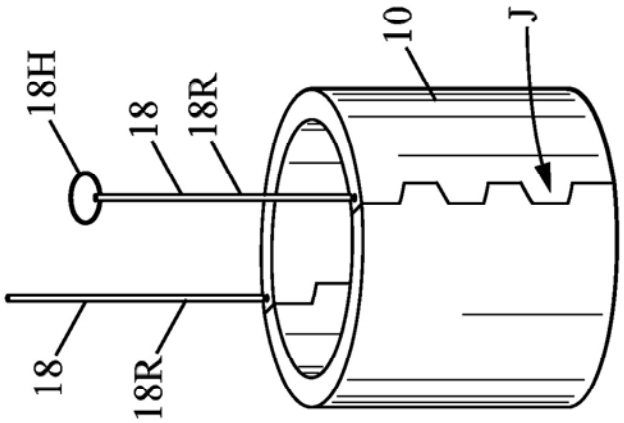


FIG. 2c

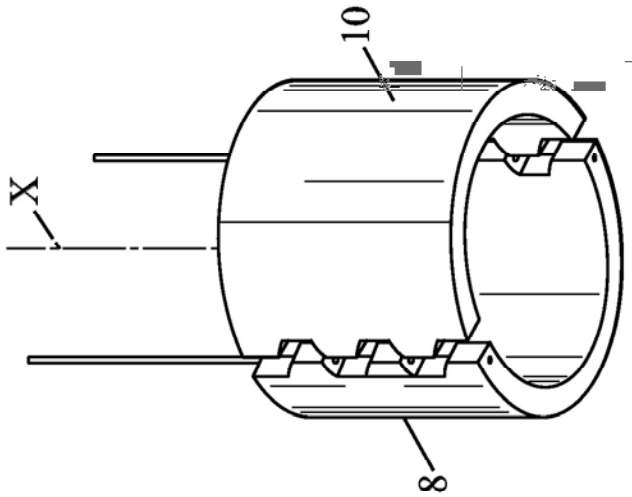


FIG. 2b

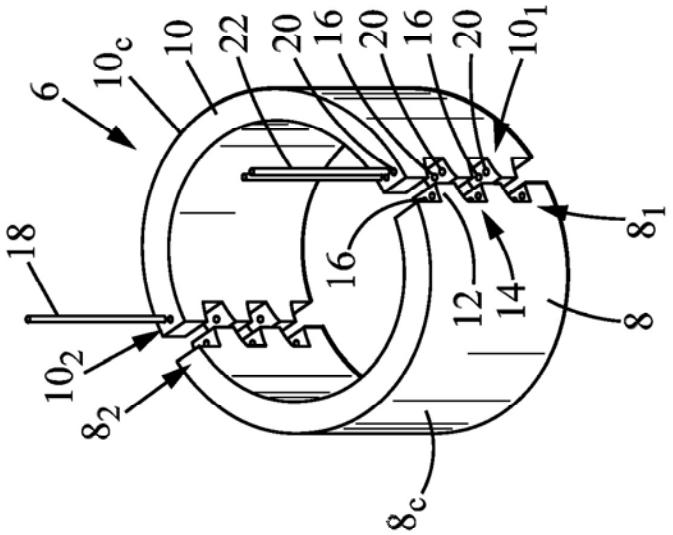


FIG. 2a

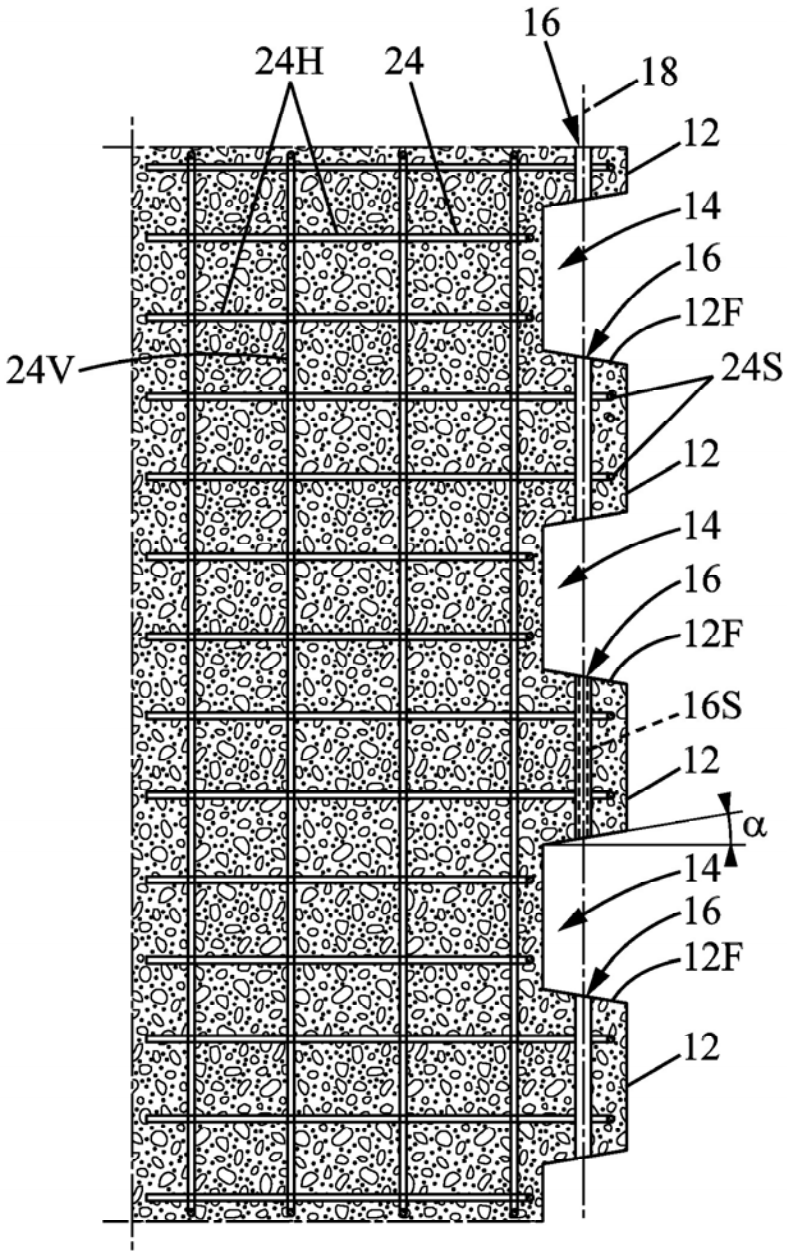


FIG. 3

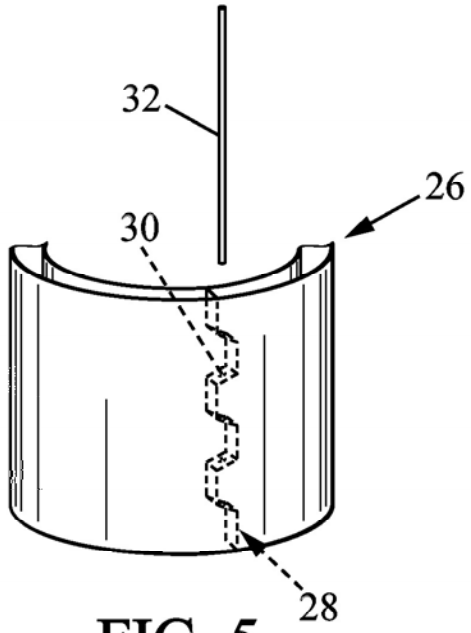


FIG. 5

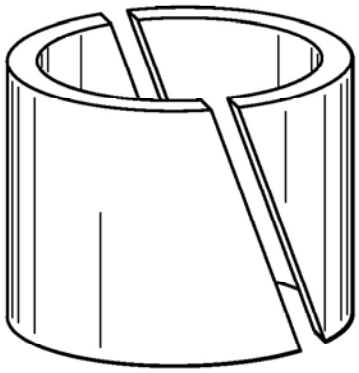


FIG. 6

INTERNATIONAL SEARCH REPORT

International application No
PCT/IB2015/001970

A. CLASSIFICATION OF SUBJECT MATTER
INV. E04B1/04 E04H12/12 F03B11/04
ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
E04B F03D E04H F03B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	DE 30 24 647 A1 (CONTRACTBAU GES FUER INGENIEUR [DE]) 21 January 1982 (1982-01-21)	1-3,7-19
A	page 13, paragraph second - page 15, paragraph first; claim 12; figure 4	5,6

X	WO 2013/022341 A1 (MECAL B V [NL]; BRUGHUIS FRANCISCUS JOHANNES [NL]) 14 February 2013 (2013-02-14) the whole document	1-3,8-16

X	EP 2 857 614 A1 (SAENZ SAENZ FRANCISCO JOSE [ES]) 8 April 2015 (2015-04-08) the whole document	1-4,8-16

X	WO 2015/015103 A1 (SOLETANCHE FREYSSINET [FR]) 5 February 2015 (2015-02-05) the whole document	1-3,7-16

☐ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
2 March 2016	09/03/2016

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Valenta, Ivar

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/IB2015/001970

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
DE 3024647 A1	21-01-1982	NONE	
WO 2013022341 A1	14-02-2013	CA 2844203 A1	14-02-2013
		CN 103857857 A	11-06-2014
		EP 2739796 A1	11-06-2014
		NL 2007231 C	06-02-2013
		US 2014202107 A1	24-07-2014
		WO 2013022341 A1	14-02-2013
EP 2857614 A1	08-04-2015	EP 2857614 A1	08-04-2015
		WO 2015049362 A1	09-04-2015
WO 2015015103 A1	05-02-2015	AU 2014298305 A1	11-02-2016
		CA 2917701 A1	05-02-2015
		FR 3009318 A1	06-02-2015
		WO 2015015103 A1	05-02-2015

Annexure E

Tough Guy Patent Attorneys

12 Heavy Street

Rough Neighbourhood
Pretoria

26 March 2025

Smart & Smarter Patent Attorneys
Cape Town

Dear Sir/Madam,

Re: South African Patent No. 2018/08751 entitled Wind Turbine Tower with Reinforcing Elements

WITH PREJUDICE

1. We write to you on behalf of Two Towers Manufacturing (Pty) Ltd ("our client").

2. Our client is aware of the existence of South African patent No. 2018/08751 entitled "Wind Turbine Tower with Reinforcing Elements" in the name of Two Towers Manufacturing (Pty) Ltd ("the patent"). The patent has a priority date of 14 December 2017.

3. The official Register lists Smart & Smarter as the address for service of the patent.

4. Our client will begin construction of several wind turbine projects in South Africa in 2025, which will include wind turbine towers that will likely fall within the scope of the claims of the patent.

5. The patent is invalid as the alleged invention:

5.1 is not novel as it formed part of the state of the art immediately before the priority date of the alleged invention; and

5.2 does not involve an inventive step as it is obvious to a person skilled in the art, having regard to the matter made available to the public before the priority date of the alleged invention.

6. The state of the art and matter made available to the public referred to in the preceding paragraphs include the Rio Do Norte Wind Farm in Brazil, which was constructed in 2013, and which has wind turbine towers with reinforcing elements as claimed in the patent. We attach details of the Rio Do Norte Wind Farm.

7. In the light of the clear invalidity of the patent, we have been instructed to demand that the patentee provide our client with a written undertaking that it will not institute any proceedings against our client for infringement of the patent, and that it will not seek an interdict against our client in respect of any alleged infringement of the patent.

8. Should we not receive the undertaking as aforesaid within ten business days from the date hereof, our client intends to apply for the revocation of the patent.

9. We look forward to receipt of the undertaking.

Yours sincerely,

Tough Guy

Attached:

Annexure: Photographs and documentation of the Rio Do Norte Wind Farm in Brazil

Annexure to Letter of Demand:
Photographs and documentation of the Rio Do Norte Wind Farm in Brazil

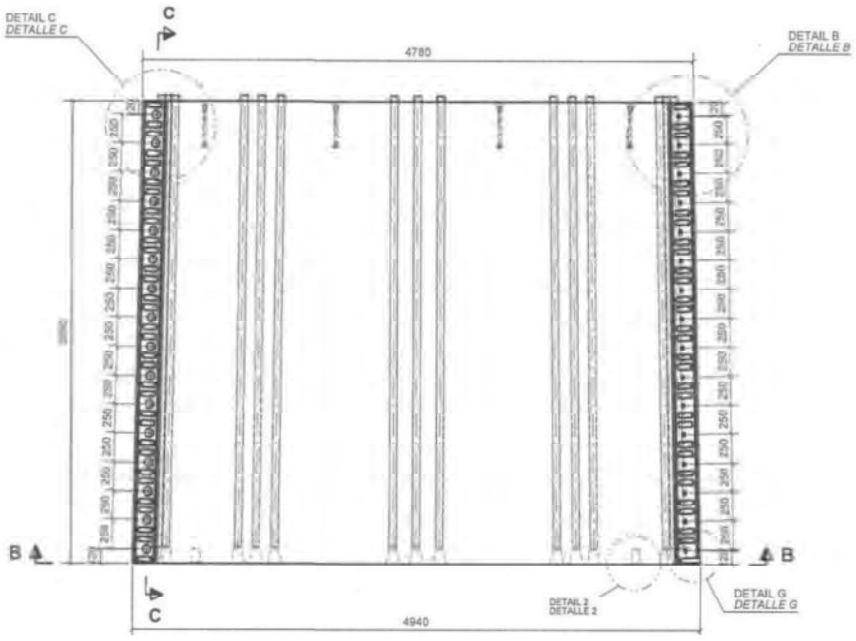
1/ BRAZIL 2013 – Rio Do Norte Wind Farm with WTG GE1.6 MW - HH110 m

PHOTOS:



DESIGN: Certified Design by TUV NORD

UPPER REGION	LOWER REGION
Drawing: Geometry M12-1	Drawing: Geometry M01-1
Distance between bars – D1 = 250 mm	Distance between bars – D2 = 400 mm
Number of bars = 16	Number of bars = 10
Cross section= ø 20	Cross section= ø 20



ation

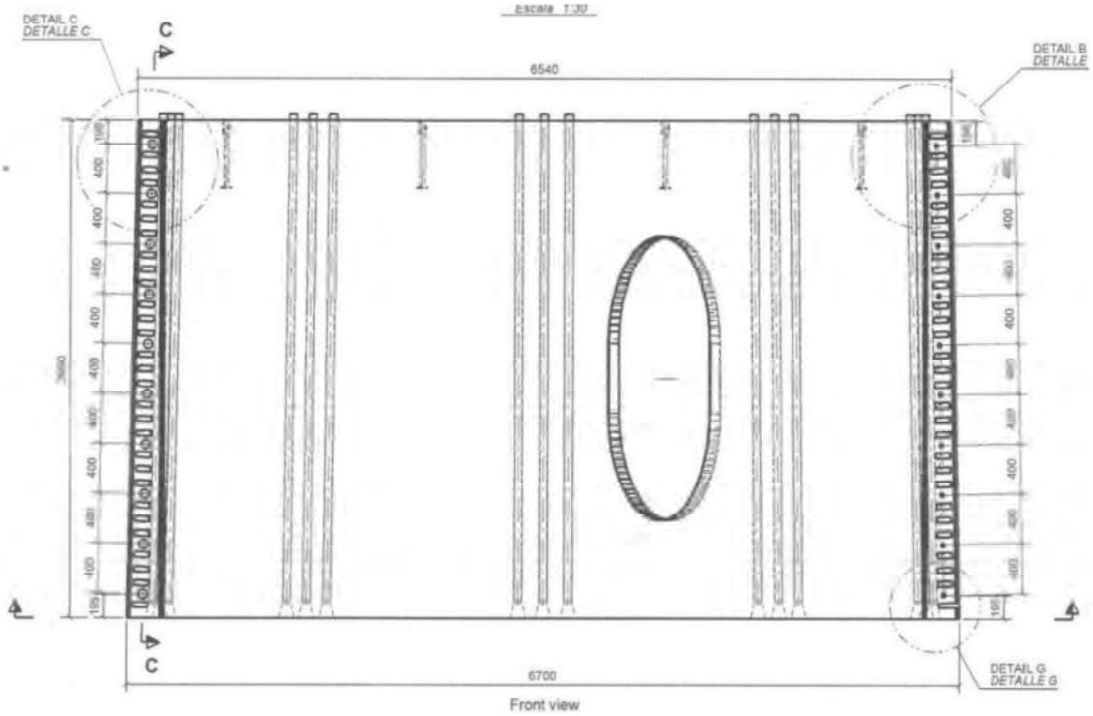


Table 22 – **Crossing reinforcement in vertical joints**

Tower height, h (m)	Module	Diameter, ϕ_b (mm)	Spacing, s_b (mm)	Amount, n_b
0,00-4,00	M01	20	400	10
4,00-8,00	M02			
8,00-12,00	M03			
12,00-16,00	M04			
16,00-20,00	M05			
20,00-24,00	M06			
24,00-28,00	M07			
28,00-32,00	M08		310	13
32,00-36,00	M09			
36,00-40,00	M10			
40,00-44,00	M11			
44,00-48,00	M12		250	16
48,00-52,00	M13			
52,00-56,00	M14			
56,00-60,00	M15			

(Reference: D001-P001-T01_01 Compliance report)

Annexure F

Form P 20

REPUBLIC OF SOUTH AFRICA
PATENTS ACT, 1978
IN THE COURT OF THE COMMISSIONER OF PATENTS
APPLICATION FOR REVOCATION
(Section 61 – Regulation 89)

Full name of applicant:
TWO TOWERS MANUFACTURING (PTY) LTD

Full name of patentee:
WIND UP ENERGY (PTY) LTD

Patent No.		ZA	2018/08751

Grounds for revocation:

A. That the invention claimed in claims 1 to 5 is not patentable under section 25 of the Patents Act, 57 of 1978 ("the Patents Act") in that the claimed invention formed part of the state of the art immediately before the priority date of the patent. (Section 61(1)(c) read with ss 25(1), (5) and (6))

B. That the invention claimed in claims 1 to 6 is not patentable under section 25 of the Patents Act in that the claimed invention does not involve an inventive step having regard to the matter made available to the public immediately before the priority date of the patent. (Section 61(1)(c) read with ss 25(1), (5), (6) and (10))

C. Claim 6 of the complete specification of the patent is not fairly based on the matter disclosed in the specification. (Section 61(1)(f)(ii))

Dated at ..... this 17th day of June 2025

TOUGH GUY PATENT ATTORNEYS
Applicant's Patent Attorneys
Rough Neighbourhood
PRETORIA

0/

TO:

SMART & SMARTER
Patentee's Patent Attorneys
CAPE TOWN

AND TO:

The Registrar of the Above Honourable Court
The Patent Office
The DTI Campus (Block F – Entfutfukweni)
PRETORIA

0/

IN THE COURT OF THE COMMISSIONER OF PATENTS
FOR THE REPUBLIC OF SOUTH AFRICA

CASE NO: 2018/08751

In the matter between:

TWO TOWERS MANUFACTURING (PTY) LTD Applicant

and

WIND UP ENERGY (PTY) LTD Respondent (Patentee)

in re: Application for the Revocation of South African Patent No. 2018/08751

STATEMENT OF PARTICULARS

---

1. The Applicant is TWO TOWERS MANUFACTURING (PTY) LTD, a company incorporated under the laws of South Africa, of Shady Business Park, Somewhere, Westen Cape, 7451, South Africa.

2. The Patentee is WIND UP ENERGY (PTY) LTD, a company organised and existing under the laws of South Africa, of 2 Somewhere Street, Nowhere, Western Cape, 7601, South Africa.

3. South African patent number 2018/08751 ("the patent") was filed on 14 December 2018 and was granted on 24 June 2021. The patent claims priority from European patent application number 17380003.3 filed on 14 December 2017 ("the priority date of the invention").

AD GROUND A

4. The invention as claimed in claims 1 to 5 of the patent formed part of the state of the art immediately before the priority date of the invention.

5. The state of the art includes the following matter which was made available to the public:

5.1 The Rio Do Norte Wind Farm in Brazil, which was constructed in 2013, and which has wind turbine towers with reinforcing elements as claimed in claims 1 to 5 of the patent.

0/

6. Accordingly, the invention claimed in claims 1 to 5 is not new and is therefore not patentable, and the patent should be revoked pursuant to Section 61(1)(c) read with Sections 25(1), (5) and (6) of the Patents Act.

AD GROUND B

7. The subject matter claimed in claims 1 to 6 of the patent does not involve an inventive step, as it was obvious to a person skilled in the art having regard to matter that was available to the public immediately before the priority date of the patent.

8. The matter that was available to the public immediately before the priority date of the patent includes:

8.1 The matter referred to in paragraph 5.1 above:

8.2 International Publication No WO2017/046624 A1.

9. Accordingly, the invention claimed in claims 1 to 6 does not involve an inventive step, and the patent should be revoked pursuant to Section 61(1)(c) read with Section 25(1), (5), (6) and (10)) of the Patents Act.

AD GROUND C

10. Claim 6 of the complete specification of the patent is not fairly based on the matter disclosed in the specification.

11. In particular, claim 6 of the patent is not fairly based on the matter disclosed in the specification, as the specification has no disclosure of a wind turbine tower with at least two reinforcing elements (4) in the upper region (5) and at least two reinforcing elements (4) in the lower region (6) and a first distance (D1) along the height of the tower between reinforcing elements (4) of the upper region (5) being greater than a second distance (D2) between reinforcing elements (4) of the lower region (6).

12. Accordingly, the patent should be revoked pursuant to Section 61(l)(f)(ii).

WHEREFORE the Applicant prays:

(a) for an order that South African patent number 2018/08751 be revoked;

(b) for an award of costs, including the costs of two counsel and expert witnesses, in favour of the applicant if this application is opposed; and

(c) for an order granting the applicant further and/or alternative relief.

0/

DATED AT PRETORIA ON THIS 25TH DAY OF JUNE 2025

TOUGH GUY PATENT ATTORNEYS
Applicant's Patent Attorneys
Rough Neighbourhood
PRETORIA

TO:

SMART & SMARTER
Patentee's Patent Attorneys
CAPE TOWN

AND TO:

The Registrar of the Above Honourable Court
The Patent Office
The DTI Campus (Block F – Entfutfukweni)
PRETORIA