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(54) **STRUCTURAL SUPPORT SLEEVE**

(57) The present invention relates to a sleeve (1) for supporting a structural element (2), the sleeve comprising a first (3) and a second (4) semi-cylindrical element for enclosing the structural element to be supported, wherein at least one of the first or second semi-cylindrical elements comprise one or more compartments (5) for housing monitoring equipment.

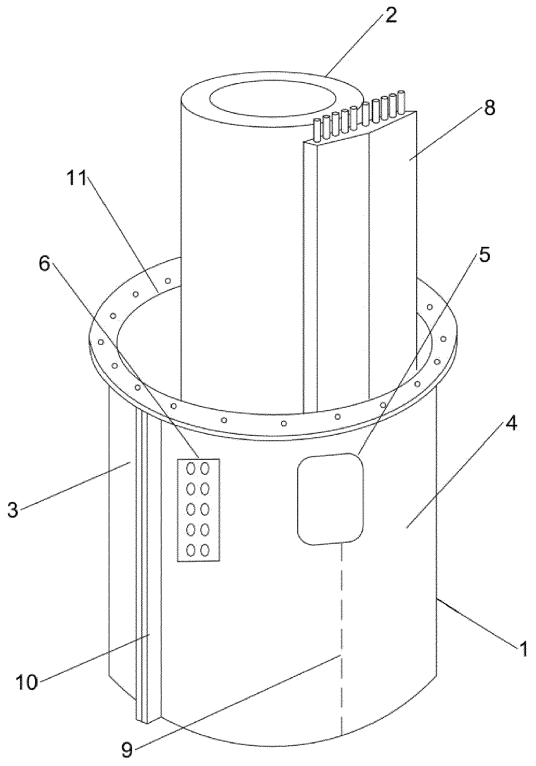

Figure 1

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Description

Field of the Invention

[0001] The present invention relates to an apparatus for supporting an existing structural element. In particular it is directed to an apparatus for supporting and facilitating analysis of a monopole type structure.

Background to the Invention

[0002] Mobile telecommunication devices have become ubiquitous in recent times. These devices rely on a network of antennas to provide connectivity. Each new generation of network leads to greater demand for reliable connectivity and higher data throughput. As such, this leads network operators to upgrade and expand their antenna networks. Antennas may be supported by a number of structure types. One common structure type is a so called monopole or monopole tower. A monopole is a single structural pole, tower or stem which is typically self-supporting. Such monopoles can be of significant height. Placing telecommunications antennas on a monopole increases the structural load on the pole. Overloading of the pole can lead to undesirable swaying or vibration in the monopole structure. This can lead to detachment of antennas or even failure of the monopole structure itself.. Furthermore, a common problem on monopole structures is excessive movement of transmission antennas (parabolic dishes). This movement is difficult to predict. As such, there exists a need to provide structural support to a monopole structure and facilitate investigation of the structural loading of the structure.

Summary of the Invention

[0003] The present invention provides a sleeve for supporting a structural element, the sleeve comprising a first and a second semi-cylindrical element for enclosing the structural element to be supported, wherein at least one of the first or second semi-cylindrical elements comprise one or more compartments for housing monitoring equipment.

[0004] This is advantageous as it provides for support of an existing structural element while providing integrated components for housing monitoring equipment. As such, a structural element supported by the sleeve may be easily equipped with equipment for analysis of loading and overall performance of the element. This provides additional functionality to a simple cladding type support sleeve as the compartments may be easily filled with equipment. This obviates the need to externally strap or mount monitoring equipment onto the structural element. Furthermore, with monitoring equipment installed, the sleeve of the present invention can provide an early warning system where transmission antenna movement is likely. This would in turn reduce the need for operatives to repair transmission links in the field, which is a common problem in mobile telecommunications. Conversely, desktop studies of structural elements can produce overly conservative movements which do not occur in the real world. This can result in unnecessary remedial works being carried out. The present invention thus provide for reducing unnecessary remedial works.

[0005] The one or more compartments may be integrated into an external convex surface of the first or second semi-cylindrical elements. This provides that the compartments may form part of an outer surface of at least one of the semi-cylindrical elements. Thus, when viewed externally, the compartments may be raised proud from the surface of the semi-cylindrical elements.

[0006] The one or more compartments may be integrated into an internal concave surface of the first or second semi-cylindrical elements. This provides that the compartments may form part of an inner surface of at least one of the semi-cylindrical elements. Thus, when viewed externally, the compartments may be recessed into the surface of the semi-cylindrical elements.

[0007] The one or more compartments may be accessible via a sealable opening in the surface of at least one of the first or second semi-cylindrical elements. The sealable opening may be a hatch, door or slot. This provides ease of access to the compartments, for example, to install, repair or replace equipment in a compartment.

[0008] At least one of the first or second semi-cylindrical elements may comprise one or more integrated brackets. This is advantageous as it provides for ease of mounting of equipment. This obviates the need for additional bracketing or further restraints to be added to the structural element should equipment be attached to the element. The integrated brackets may be integrated into an internal concave surface of the first or second semi-cylindrical elements. The integrated brackets may be integrated into an external convex surface of the first or second semi-cylindrical elements. Furthermore, the integrated brackets may be integrated into both an internal and external surface of the first or second semi-cylindrical elements.

[0009] The one or more compartments may further comprise one or more openings. The openings may comprise drilled holes. These openings may be in addition to the sealable openings. The openings provide for cabling, which may be attached to monitoring equipment in the compartments, to exit the compartment for connection to equipment elsewhere on the structural element.

[0010] The first and second compartments may be fabricated from galvanised steel. This provides for a robust structure which can adequately house and protect equipment.

[0011] The structural element may be a monopole. This is advantageous as the sleeve provides for structural support of the monopole while facilitating analysis of the monopole structure. The sleeve is easily fitted to a monopole and the compartments provide for ease of installation of monitoring equipment.

[0012] The present invention further provides a mo-

nopole structure comprising at least one sleeve, the monopole structure being supported by the sleeve. The sleeve comprising a first and a second semi-cylindrical element for enclosing the monopole wherein at least one of the first or second semi-cylindrical elements comprise one or more compartments for housing monitoring equipment. The one or more compartments may comprise monitoring equipment for monitoring the structural performance of the monopole structure. Thus, the structural performance of the monopole may be readily assessed by equipment housed on the monopole itself. Thus, the sleeve provides that the monopole may be easily upgraded from a standalone tower requiring external measurement and analysis to a "smart" tower wherein monitoring equipment may easily integrated into the tower for either onsite or remote monitoring.

Description of the Drawing

[0013]

Figure 1 is a schematic cutaway representation of a monopole structure and the sleeve of the present invention

Figure 2 is a schematic representation of a monopole structure and the sleeve of the present invention

Description of the Drawings

[0014] The present invention provides a sleeve for supporting a structural element. It is particularly suitable for use with a monopole type structural element.

[0015] **Figure 1** is a schematic representation the sleeve 1 of the present invention fitted to a monopole 2 structure. The sleeve comprises a first and a second semi-cylindrical element 3, 4 for enclosing the monopole. While in the example shown, the first and second element are semi-cylindrical in shape, different partial cylinder shapes could also be used. For example, a quarter cylinder shape could be utilised with the four quarters being merged to form a full cylinder. Further fractional cylinder shapes may also be utilised. In the example shown, the semi-cylindrical element comprises a compartment 5 for housing monitoring equipment. In the example shown, the compartment is integrated into an internal concave surface of the semi-cylindrical elements. Thus, the compartment provides a recessed area into which monitoring equipment may be fitted. The compartment itself may be subdivided into a plurality of smaller compartments. Each compartment may be used separately to house equipment. In an alternative embodiment, the compartment is integrated into an external convex surface of the semi-cylindrical elements. Thus, the compartment provides raised area on the semi-cylindrical element into which monitoring equipment may be fitted. Furthermore, a combination of recessed and raised compartments may be provided. The compartment may be constructed from material which is resistant to corrosion. The compartment may be constructed such that it is sufficiently robust to be considered "weatherproof'.

[0016] An integrated bracket 6 is provided for mounting of equipment onto the monopole. The brackets and compartments as described may be fabricated from galvanised steel.

[0017] **Figure 2** is a schematic representation of a monopole structure and the sleeve of the present invention. Figure 2 further shows that multiple sleeves may be mounted one atop another, such that a monopole is encased along its height by a plurality of sleeves. In this manner, the monopole is "wrapped" by the sleeve. Figure 2 further shows a sealable opening 7 in the surface of one of the semi-cylindrical elements of the sleeve. The opening 7 may be provided in any of the semi-cylindrical elements to provide access to the compartments. The opening provides for ease of access to equipment housed in the compartment. The opening is equipped with a fold out platform 12 or table which provides a surface for operatives to, for example, rest a laptop for connection to equipment housed in the compartment. Typically, the fold out platform or table is fabricated externally adjacent to the opening.

[0018] The compartment may further comprise one or more openings. The openings may comprise drilled holes. These opening may be on a back surface or wall of the compartment and provide that equipment housed in the compartment may have cables 9 run through the opening for ease of connection to equipment installed elsewhere on the monopole. A dedicated internal cable management system for the cables 9 may be provided. This ensures that cables 9 are separated from to existing cables 8 (as shown in Figure 1) in situ on the monopole. The cable management system may provide an enclosure for protection of the cables 9. Cables 9 may be used to connect equipment housed in one sleeve, for example, at the base or toward the ground level end of a monopole, with equipment housed in a further sleeve, for example higher up the monopole. Typically, the monitoring equipment housed in a compartment is data analysis or data storage equipment. This equipment is connected to measurement equipment, typically attached to the external surfaces of the monopole, for example via the brackets 6. As such, readings obtained by the measurement equipment may be analysed and stored by the data analysis or data storage equipment. The measurement equipment may include equipment to measure structural information such as loading, deflection, frequency, damping, inclination and stress and strain information. Wind speed and pressure measurements may also be obtained. Information from one or more of the measurement equipment devices may be transferred via the cables 9 to the monitoring equipment. Accordingly, information from the full height of the monopole may be obtained by suitable equipment. Thus the sleeve (or the use of multiple sleeves) provides that the monopole may be easily upgraded from a standalone tower requiring external measurement and analysis to a "smart" tower wherein moni-

toring equipment may easily integrated into the tower for either onsite or remote monitoring.

[0019] A monopole owner typically wishes to maximise the number of antennas or other equipment supported by the structure such that the monopole provides the best performance both in terms of quality of transmission and revenue generation. As such, monopole owners frequently wish to add additional antennas to existing structures. However, there exists a problem whereby the amount of additional loading which a monopole can accommodate is difficult to ascertain. As such, monopole owners rely on estimates of loading, which in the worst case scenario may lead to over-loading and failure of the structure. Similarly, under-loading of the structure is undesirable as this means that the performance and revenue capability of a monopole is not being maximised. These problems are addressed by the present invention. Use of the sleeve of the present invention is now described.

[0020] A monopole structure is identified. The monopole is typically a pre-existing structure being used to support one or more pieces of transmission equipment such as antennas for mobile communication. The first and second semi-cylindrical elements are placed about opposite sides of the monopole. The first semi-cylindrical element of the sleeve is brought in contact to merge with the second semi-cylindrical element of the sleeve such that the monopole structure is housed within the cylindrical structure resulting from the merging of the first and second semi-cylindrical elements. The monopole is thus now "wrapped" or encased by the sleeve. The first and second semi cylinders may be fixed together by bolts fastened through holes in a lip 10 about the outer edge of the semi-cylinders. Once in place, a further sleeve may be added atop the installed sleeve. Sleeves may be attached to each other, again using bolts, fastened through holes in a flange 11 about the ends of the semi-cylinders. Once installed, monitoring equipment may be placed into compartments on the sleeve elements. Alternatively, the one or more sleeves may be fitted to a monopole with monitoring equipment preinstalled into one or more of the compartments. With the monitoring equipment installed, structural health monitoring (SHM) of the monopole may be undertaken. As described above, the monitoring equipment may obtain and assess information from one or more pieces of measurement equipment fitted to the monopole. Structural information such as loading, deflection, frequency, damping, inclination and stress and strain information may be obtained and provided to the monitoring equipment. Wind speed and pressure information may also be measured. Information from the monitoring equipment may be obtained onsite, whereby an operative accesses one or more compartments through an opening in the sleeve element. Alternatively, this information may be obtained remotely whereby the monitoring equipment transmits information regarding the structural health of the monopole to an operative, the information being received by a computer or mobile device. In this manner, "live" monitoring of the structural performance of a monopole may be undertaken. Use of the sleeve of the invention as described provides that safe loading of the monopole may be accurately calculated. It further provides that overloading of a monopole structure may be anticipated and mitigating actions may be recommended and undertaken.

[0021] The words "comprises/comprising" and the words "having/including" when used herein with reference to the present invention are used to specify the presence of stated features, integers, steps or components but do not preclude the presence or addition of one or more other features, integers, steps, components or groups thereof.

[0022] It is appreciated that certain features of the invention, which are, for clarity, described in the context of separate embodiments, may also be provided in combination in a single embodiment. Conversely, various features of the invention which are, for brevity, described in the context of a single embodiment, may also be provided separately or in any suitable sub-combination.

Claims

1. A sleeve for supporting a structural element, the sleeve comprising:

   a first and a second semi- cylindrical element for enclosing the structural element to be supported,
   wherein at least one of the first or second semi-cylindrical elements comprise one or more compartments for housing monitoring equipment.

2. The sleeve of claim 1 wherein the one or more compartments are integrated into an external convex surface of the first or second semi-cylindrical elements.

3. The sleeve of claim 1 wherein the one or more compartments are integrated into an internal concave surface of the first or second semi-cylindrical elements.

4. The sleeve of any preceding claim wherein the one or more compartments are accessible via a sealable opening in the surface of at least one of the first or second semi-cylindrical elements.

5. The sleeve of any preceding claim wherein at least one of the first or second semi-cylindrical elements comprise one or more integrated brackets.

6. The sleeve of any preceding claim wherein the one or more compartments further comprise one or more openings.

7. The sleeve of claim 6 wherein the openings comprise

drilled holes.

8. The sleeve of any preceding claim wherein the first and second compartments are fabricated from galvanised steel.

9. The sleeve according to any preceding claim wherein the structural element is a monopole.

10. A monopole structure comprising a sleeve according to any of claims 1 to 8, the monopole structure being supported by the sleeve.

11. The monopole structure of claim 10 wherein the one or more compartments comprise monitoring equipment for monitoring the structural performance of the monopole structure.

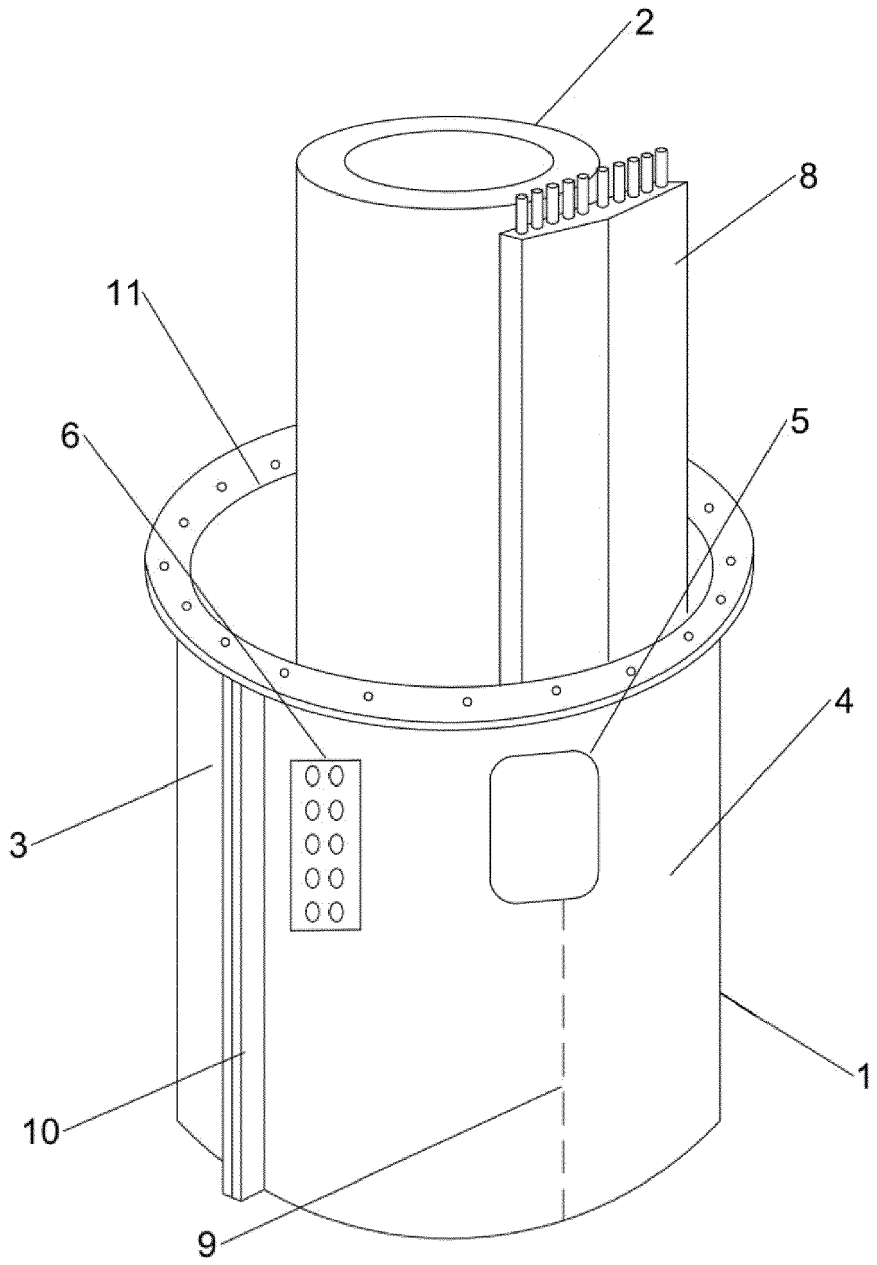

Figure 1

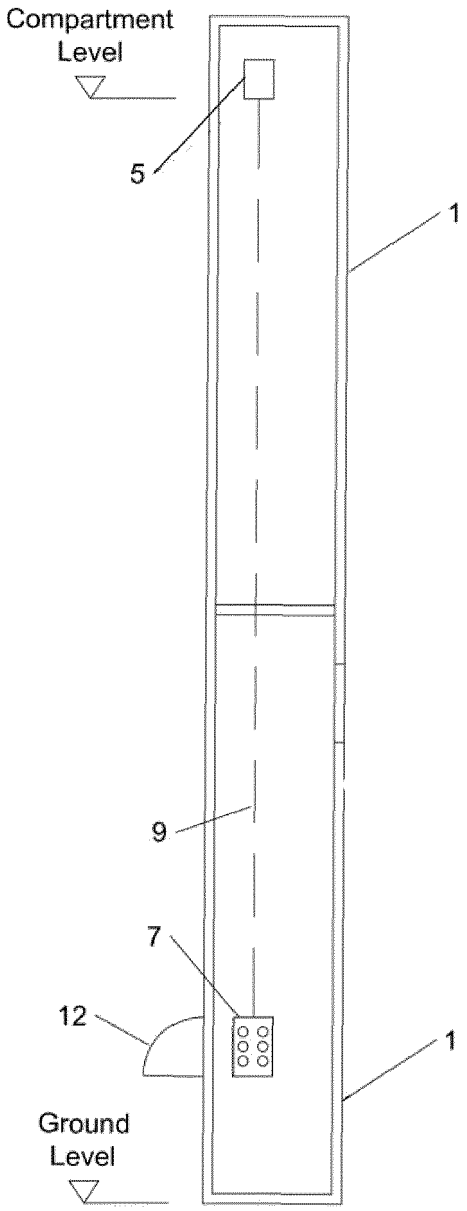

Figure 2

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EUROPEAN SEARCH REPORT

Application Number
EP 22 17 4153

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Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X Y	US 6 453 636 B1 (RITZ CHARLES D [US]) 24 September 2002 (2002-09-24) * column 5, lines 4-23; figures 1-6 * * column 6, lines 56-61 * -----	1-10 11	INV. E04H12/20 E04H12/22 H01Q1/12
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A	US 2019/221913 A1 (CASTRONOVA DANA ANTHONY [US]) 18 July 2019 (2019-07-18) * figure 4B * -----	7	
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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	7 October 2022	Rosborough, John

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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A : technological background
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E : earlier patent document, but published on, or after the filing date
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