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(54) **DISSIPATOR PANELS AND RESPECTIVE BUILDING SYSTEM**

(57) This application describes dissipator panels for seismic reinforcement of buildings that reduce the seismic vulnerability of the constructions that incorporate them, and the respective construction system.

Each dissipator panel corresponds to a flat articulated structure comprised of a dissipative central device (1), by diagonals (2), uprights (3), crossbars (4) and connections (5). The uprights (3) correspond to the vertical elements and the crossbars (4) to the horizontal elements,

which are placed at the level of the floors. The uprights (3) and the crossbars (4) form a square or rectangular flat structure. The central dissipator (1) is positioned by matching its geometric center with the intersection of the diagonals of the parallelogram formed by the uprights (3) and by the crossbars (4). To the central dissipator device (1) the diagonals (2) of the dissipator panels are connected, corresponding to inclined bars according to the diagonals of the parallelogram.

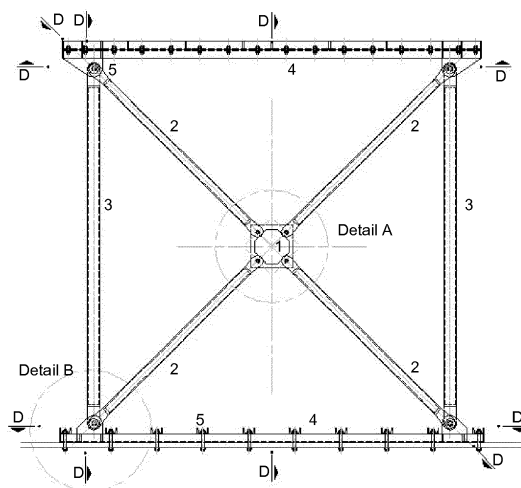


Figure 1

Description

Technical field

[0001] THE present application describes dissipator panels for seismic reinforcement of building structures, including those consisting of resistant walls of masonry and wooden floors and heritage buildings, and relates to the respective constructive system.

Background

[0002] In the reconstruction of downtown Lisbon and, to a lesser extent, other urban agglomerations affected by the 1755 earthquake, innovative anti-seismic provisions were introduced deliberately and systematically. Among those provisions, it is highlighted the construction of a three-dimensional internal structure of wood, known as "pombaline cage". The allusion to the Marquis of Pombal is due to the responsibility attributed to him in rebuilding Lisbon after the disaster that devastated the city in 1755.

[0003] The cage is comprised by triangular inner walls with pombaline front, also known as pombaline frontals or simply by front and by the wooden structures of floors and roofing. Besides the latching function of the resistant stone masonry exterior walls, the front used to serve as a floor support and as partition walls [1].

[0004] The large-scale rehabilitation of the most vulnerable building typologies is one of the solutions that most contributes to the mitigation of global seismic risk, justifying the design and development of proven solutions and with additional advantages compared with traditional methods.

[0005] The dissipator panels referred to in the present patent object correspond to a system that allows improving the structural safety of buildings against seismic action, thus reducing damage resulting from the referred action over the buildings.

[0006] In recent years, new systems for seismic protection in constructions have arisen, as an alternative to the traditional approach based on exploitation of the of the structures' ductile capacity, which implies the formation of a mechanism based on plastic hinges that only develop at significant levels of deformation [2,3].

[0007] Currently, the constructions - the ones built from scratch and the existing - can be endowed with seismic protection systems, that enable the prevention of severe damage, and the limitation of losses, more effectively than the traditional approach, which is based on exploitation of the deformation capacity of the structures beyond the elastic limit, at the expense of more or less extensive and irreversible damage.

[0008] The new seismic protection systems allow maintaining the operability and functionality of constructions, immediately after the occurrence of high intensity earthquakes. They also ensure the protection of the contents, components, equipment and secondary structural

elements of constructions [4,5].

[0009] Among the protection systems, the energy dissipation systems are highlighted, which correspond to devices designed to dissipate high levels of energy. However, none of the solutions known in the prior art allows seismic energy dissipation capacity similar or close to the technology now presented in this application and simultaneously it constitutes a preconceived constructive technology with predefined mechanical characteristics, ready to use, slightly intrusive and easy to replace.

Summary

[0010] The present application describes a dissipator panel that comprises the following elements:

- central dissipative device (1);
- diagonals (2);
- uprights (3);
- crossbars (4);
- connections (5).

[0011] In one embodiment, the uprights of the dissipator panel are constituted by metallic or composite material profiles and are positioned vertically between the floors of the building.

[0012] In another embodiment, the sleepers of the sink panel are constituted by metallic or composite material profiles and are positioned in the horizontal direction at the level of the building floors.

[0013] In yet another embodiment, the uprights and sleepers of the sink panel form a square or rectangular flat structure, in which intersection of the diagonals the central dissipative device is placed and to which the diagonals, belonging to said sink panels, are connected.

[0014] In one embodiment, the dissipator panel comprises a dissipator device connected to four diagonals, which in turn are articulated with the crossbars and the uprights by means of mechanical connections at the level of the floors.

[0015] In another embodiment, the diagonals of the dissipator panel are positioned in the two diagonal directions of the parallelogram formed by the uprights and the crossbars.

[0016] In yet a further embodiment, the diagonals of the dissipator panel are built on metal or composite material.

[0017] In one embodiment, the central dissipator device of the dissipator panel is hysteretic or viscous type.

[0018] In yet a further embodiment, the heat dissipator panel is fixed to the floors along its upper and lower contour.

[0019] In one embodiment, the crossbars of the dissipator panel are placed symmetrically relative to the median plane of the structural system of the floors.

[0020] The present application further describes a seismic rehabilitation system of structures, comprising at least one dissipator panel as described above.

[0021] Lastly, the present application further describes the building comprising at least one dissipator panel as described above.

General description of the invention

[0022] This application discloses dissipator panels used for seismic reinforcement, allowing increasing significantly the energy dissipation capacity of the structures and hence improving the overall seismic behaviour of buildings.

[0023] The dissipator panels are comprised by a central dissipator device and by diagonals, uprights, cross-bars and connections, the group of these elements forming an articulated flat structure.

[0024] The technology now presented reduces the seismic vulnerability of buildings. The incorporation of dissipator panels on the structural system of the buildings is reflected in the reduction of the damages resulting from the seismic action. The global seismic behaviour of the reinforced buildings relatively to non-reinforced shows a significant improvement, both in terms of effort, either in deformation, as well as an increase in the energy dissipation capacity.

[0025] Additionally, the dissipator panel enables significant improvements compared to the known solutions from the prior art, with regard to preserving the basic characteristics of constructions and safeguarding its historical and architectural value, in case of heritage.

[0026] The dissipator panels correspond to a slightly intrusive solution, compatible, easy to insert in the current structural systems. The dissipator panels are slightly intrusive since they allow the realization of minimum interventions that are compatible and do not alter the original structural scheme, avoiding or minimizing the need for cutting or demolition of existing structural elements.

[0027] The dissipator panels constitute a solution with reversibility characteristics as they are installed so that they can later be removed or supplemented, if necessary, without great difficulty and without causing significant damage to the original construction. Upon the occurrence of an earthquake, the constituent elements of the dissipator panels that show any deformations can easily be replaced with new elements.

[0028] To the installation work of the dissipator panels for seismic reinforcement, a higher efficiency of the implementation in intervention work is associated, when compared to other more common reinforcement solutions.

[0029] The conservation of buildings is an essential component of sustainable development. Rehabilitation interventions in existing structures allow improving the performance and lifetime. In case of old buildings, it also allows to preserve basic characteristics and safeguard the value as architectural and historical heritage.

[0030] The practical and methodological need to assess the sustainability of construction solutions is growing. The demand for an integrated approach that takes

into account environmental, social and economic impacts of each of the possible solutions is growing.

[0031] In this context, rehabilitation emerges as a relevant strategy, especially by allowing mitigation of impacts associated with interventions in existing constructions. Compared with the existing reinforcing solutions of structures, demolition and reconstruction of buildings, with the possible use of façades and/or the option for rehabilitation techniques based on the use of reinforced concrete and metallic structures, entail a more serious environmental impact in terms of waste production and other emissions, including greenhouse gases, energy consumption, water and materials.

[0032] The rehabilitation makes it possible to reuse of existing buildings, mostly located in residential and/or urban areas urging to revitalize. In case of historic areas, the social benefits also result from safeguarding cultural, architectural and historical values. Interventions should enable the maintenance of the buildings authenticity, without sacrificing all the relevant corresponding to the cultural and historical area from which buildings are part.

[0033] With regard to existing structures inserted in seismic risk areas, sustainability is defended by adopting proven effective measures to improve the seismic resistance capacity of the constructions, of utmost importance in view of the associated devastating consequences.

[0034] In rehabilitation interventions of constructions inserted in high seismicity regions that resort to the installation of dissipator panels, performance improvement of the existing structures is ensured and at the same time the basic characteristics of the constructions are preserved and its architectural and historical value safeguarded, in the case of heritage.

Brief description of the figures

[0035] For an easier understanding of the invention join the attached figures, which represent preferred embodiments of the invention that, however, are not intended to limit the scope of this invention.

Figure 1 illustrates a representation of the dissipator panel for seismic reinforcement and its implementation between floors, where the indicated reference numbers represent:

- (1) central dissipator device;
- (2) diagonal;
- (3) upright;
- (4) crossbar;
- (5) connections.

Figure 2 illustrates the detail A of Figure 1, which is a detail of the constituent central dissipator device of the dissipator panel for seismic reinforcement, where the indicated reference numbers represent:

- (1) central dissipator device;

- (2) diagonal;
- (5) connections.

Figure 3 illustrates the detail A of Figure 1, which is a detail of the connection between the diagonal, the upright and crossbars at the level of the floors, of the dissipator panel for seismic reinforcement, where the indicated reference numbers represent:

- (2) diagonal;
- (3) upright;
- (4) cross-bar;
- (5) connections.

Figure 4 illustrates the cut 1-1 of Figure 1, which represents the dissipator panel for seismic reinforcement, where the indicated reference numbers represent:

- (3) upright;
- (4) cross-bar;
- (5) connections.

Figure 5 illustrates the cut 2-2 of Figure 1, which represents the dissipator panel for seismic reinforcement, where the indicated reference numbers represent:

- (1) central dissipator device;
- (2) diagonal;
- (4) crossbar;
- (5) connections.

Figure 6 illustrates the cut 3-3 of Figure 1, which represents one of the connection forms of the dissipator panel for seismic reinforcement to the floors, where the indicated reference numbers represent:

- (2) diagonal;
- (3) upright;
- (4) crossbar;
- (5) connections.

Figure 7 illustrates the cut 5-5 of Figure 1, which represents the dissipator panel for seismic reinforcement, wherein the diagonal connections are illustrated, in particular, detail of the connection between the diagonals and the central dissipator device and detail of the connection between the diagonals, the uprights and the crossbars, where the indicated reference numbers represent:

- (1) central dissipator device;
- (2) diagonal;
- (5) connections.

Figure 8 illustrates the cut 4-4 of Figure 1, wherein an embodiment of the connection of the dissipator

panel for seismic reinforcement to the floors is illustrated, where the indicated reference numbers represent:

- (2) diagonal;
- (3) upright;
- (4) crossbar
- (5) connections.

Figure 9 illustrates the detail of Figure 8, representing the detail of the connection between the diagonal, the upright and the crossbars, at the level of the floors, of the dissipator panel for seismic reinforcement, where the indicated reference numbers represent:

- (2) diagonal;
- (3) upright;
- (4) crossbar
- (5) connections.

Figure 10 illustrates an application of the dissipator panels for seismic reinforcement and an embodiment of the connections to the existing structure.

Figure 11 illustrates a schematic representation of the application of dissipator panels for seismic reinforcement.

Description of the embodiments

[0036] This application discloses dissipator panels used for seismic reinforcement, allowing increasing significantly the energy dissipation capacity of the structures and hence improving the overall seismic behaviour of buildings.

[0037] The incorporation of dissipator panels in buildings allows strengthening its seismic safety. The global seismic behaviour of the reinforced buildings relatively to non-reinforced should show an improvement both in efforts and in deformation, as well as an increase in the energy dissipation capacity.

[0038] The conception of the new technology results from the combination of two aseismics principles: on the one hand, the lateral latching conferred by triangular structures and, on the other, increased energy dissipation capacity through the incorporation of recent methodologies for seismic protection.

[0039] Additionally, the basic characteristics of the constructions reinforced with dissipator panels are preserved since these reinforcing elements correspond to slightly intrusive solutions and compatible with the structural functioning of the constructions. Other distinguishing characteristics of the dissipator panels are related to the possibility of replacing component elements and with the reversibility of the reinforcing interventions that resort to its installation on buildings.

[0040] The dissipator panels are comprised by a cen-

tral device dissipator and by diagonals, uprights, crossbars and connections, forming the group of these elements an articulated flat structure, such as illustrated in Figure 1. The uprights develop vertically between floors; the crossbars are positioned in the horizontal direction at the level of the floors. The diagonals are connected to the central dissipator device and the other end thereof diagonals connections are established to the uprights and crossbars, at the level of the floors.

[0041] The dissipator panels are fixed to the floors along its upper and lower contour. Except in the case of buildings, whose structure of the floors does not allow it or if it is an end panel, the crossbars are double and are placed symmetrically in relation to the median plane of the thickness of the floors, pressing the constituent elements of these floors. The pairs of crossbars are thus connected together at the level of the floors.

[0042] All connections between the constituent elements of the dissipator panels are performed through systems appropriate to the behaviour mode designed and dimensioned such as, for example, bolted connections. In case deformations are displayed in the aftermath of an earthquake, the central dissipator device or the remaining elements that make up the dissipator panels can easily be replaced with new parts without damage.

[0043] The dissipator panels for seismic reinforcement constitute a prefabricated intervention solution, with behavioural characteristics well defined, easy to insert into current structural systems.

[0044] In every building, dissipator panels can be placed on one or more floors and in each floor can be placed one or more dissipator panels. The dissipator panels can be annexed to interior walls. On the sites of interior bays, continuity may be ensured by small rigid elements.

[0045] The dissipator panels correspond to reinforcing elements slightly intrusive, reversible and consistent with the structural mode of operation of the constructions, thus allowing to meet the requirements that should respond to interventions in old buildings, in particular, reduced intrusiveness and extent of interventions, reversibility and compatibility with the existing. Throughout this patent application, it is considered that the dissipator panels show reduced intrusiveness because they are panels that are slightly intrusive.

[0046] The central dissipator device belonging to the dissipator panel is comprehended by a polygonal piece of well-defined geometry, obtained from metal or composite material, e.g., steel, stainless steel, properly protected against corrosion steel or other equivalent material.

[0047] The uprights used in the dissipator panel are comprised by building profiles of metallic or composite material, positioned vertically between the floors of the building.

[0048] The crossbars used in the dissipator panel are comprised by building profiles of metallic or composite material, positioned horizontally, at the level of the building floors.

[0049] Diagonals used in the dissipator panel are comprised by construction profiles of metallic or composite material, positioned in two diagonal directions of the parallelogram formed by the uprights and the crossbars.

These diagonals are destined to make the connection of the central dissipator device to the constituent crossbars and uprights of said dissipator panel.

[0050] Any type of screwed mechanical articulated connection, such as steel pins or other equivalent material makes the connections between the elements of the dissipator panel.

Applications

[0051] Dissipator panels are used in seismic reinforcement interventions of buildings, aimed at increasing its seismic safety and therefore reducing its vulnerability.

[0052] The application of the dissipator panels falls under the area of seismic structural rehabilitation of constructions, by resorting to slightly intrusive techniques.

[0053] The panels correspond to an easy insertion solution on current structural systems and enable, simultaneously, to perform interventions with reduced intrusiveness and extension, reversible and compatible with the existing.

[0054] The panels are slightly intrusive, do not adulterate the basic characteristics of the constructions, are compatible with their original structural mode of operation and its installation is reversible.

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[0055]

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[0056] The present embodiment is naturally not in any way restricted to the embodiments described herein and

a person of ordinary skill in the art can provide many modification possibilities thereof without departing from the general idea, as defined in the claims.

[0057] The preferred embodiments described above are of course combinable with one another. The following claims further define preferred embodiments. 5

Claims

1. Dissipator panel comprising a central dissipative device (1) composed of a polygonal spindle in a metallic or composite material connected to four diagonals (2), which in turn are articulated to the crossbars (4), positioned in the horizontal direction at the level of the floors of a building and the uprights (3), positioned vertically between the floors of a building, by means of mechanical connections (5) performed at the level of the floors of a building. 10
2. Dissipator panel according to the preceding claim wherein the uprights (3) are constituted by profiles in metallic or composite material. 15
3. Dissipator panel according to any one of the preceding claims, wherein the crossbars (4) are constituted by profiles in metallic or composite material. 20
4. Dissipator panel according to any one of the preceding claims, wherein the diagonals (2) are positioned in the two diagonal directions of the parallelogram formed by the uprights (3) and the crossbars (4). 25
5. Dissipator panel according to any one of the preceding claims, wherein the diagonals (2) are made of steel. 30
6. Dissipator panel according to any one of the preceding claims, **characterized in that** it is fixed to the floors of a building along its upper and lower contour. 35
7. Dissipator panel according to any one of the preceding claims, wherein the crossbars (2) are placed symmetrically relative to the median plane of the thickness of the floors of a building. 40
8. System seismic rehabilitation of structures **characterized in that** it comprises at least one dissipator panel as described in any one of claims 1 to 7. 45
9. Building **characterized in that** it comprises at least one dissipator panel as described in any one of claims 1 to 7. 50

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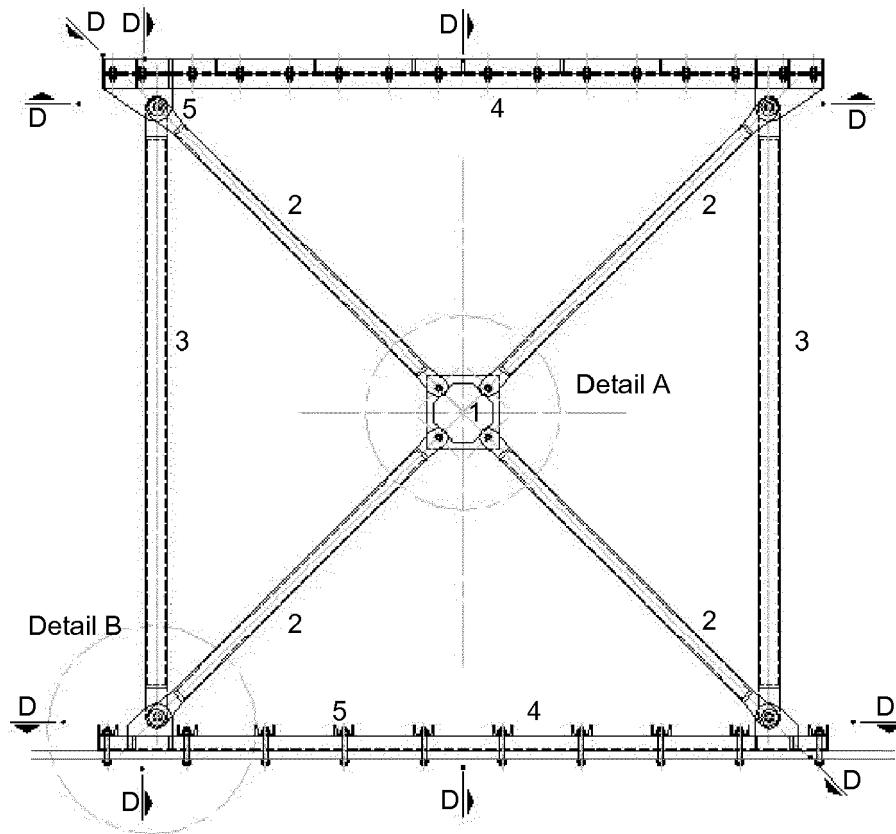


Figure 1

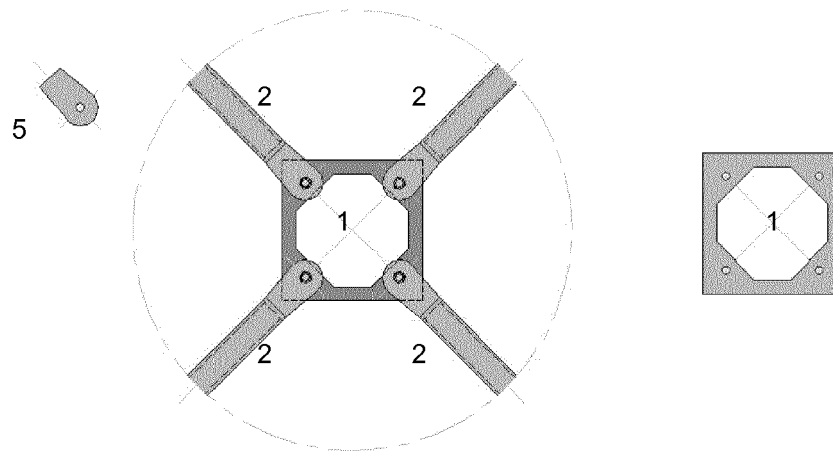


Figure 2

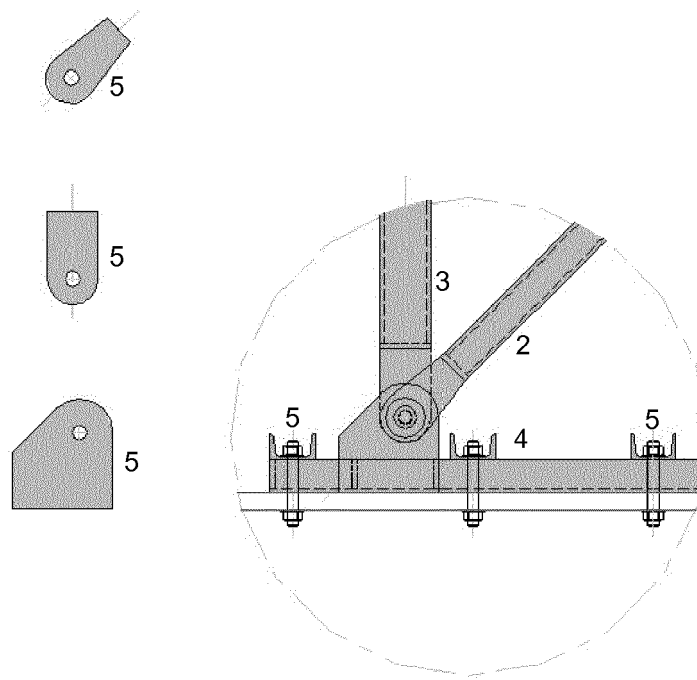


Figure 3

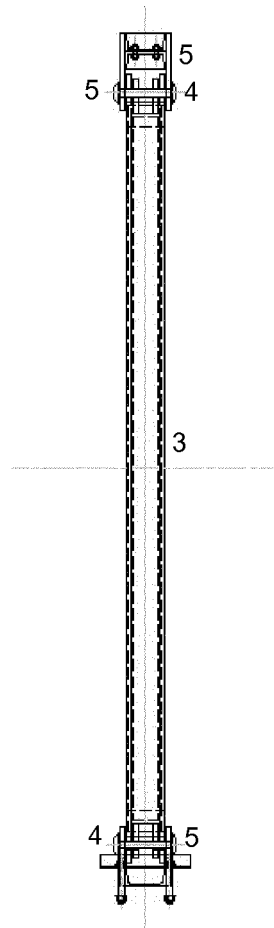


Figure 4

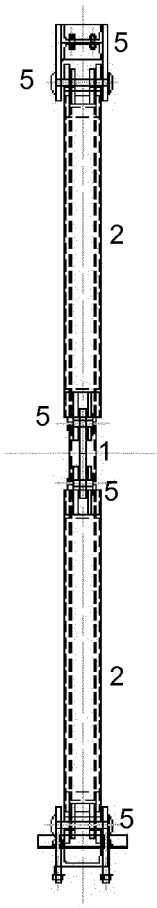


Figure 5

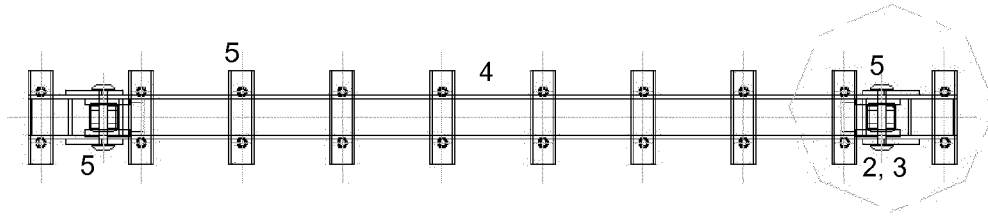


Figure 6

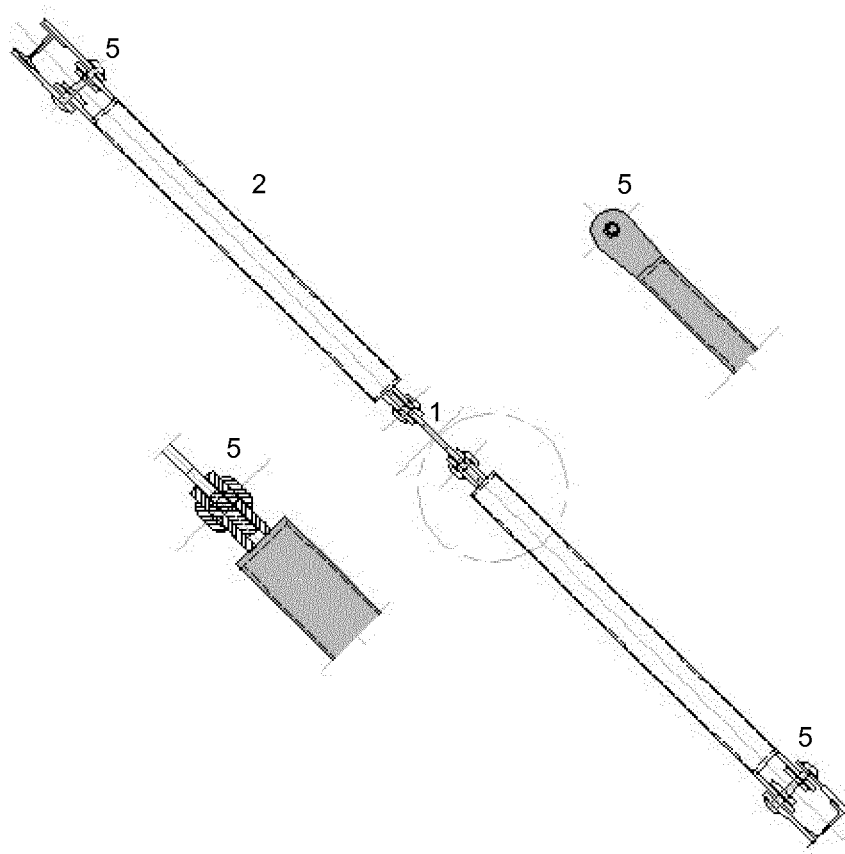


Figure 7

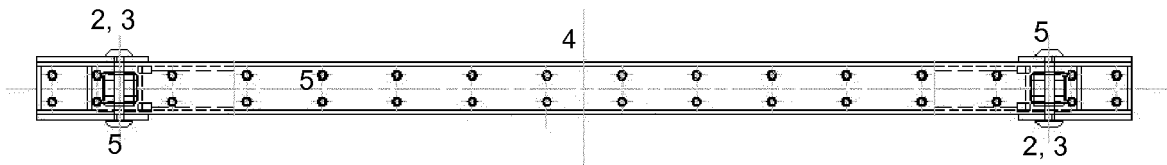


Figure 8

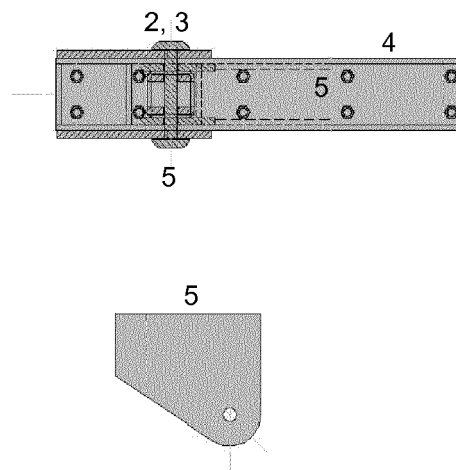


Figure 9

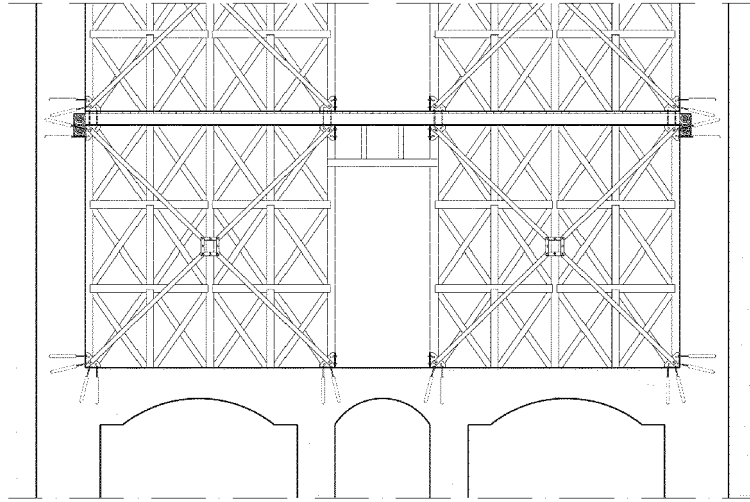


Figure 10

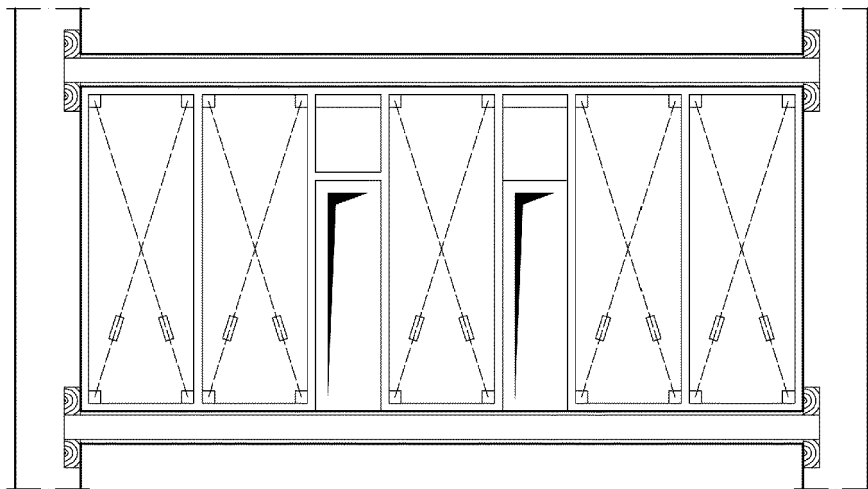


Figure 11



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