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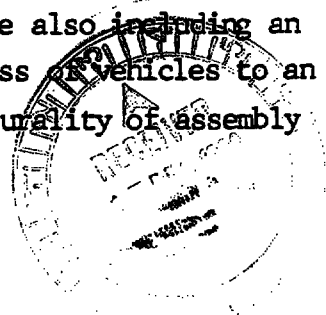
DESCRIPTIONFREE-STANDING VEHICLE PARKING STRUCTURE.

The present invention relates to a free-standing vehicle parking structure adapted to be placed on a substantially flat surface to provide a plurality of three-dimensional parking places capable of receiving parked vehicles.

Generally, structures such as a parking place providing three-dimensional parking spaces are permanently set up on the land with integral ground foundations. Building such a permanent structure, however, is costly and time-consuming. Furthermore, when it is desired to use the land for another purpose, the structure built on it must be broken down. This is a waste of the structure and requires the cost of scrapping.

It is a primary object of this invention to provide a novel vehicle parking structure which can be assembled and disassembled quickly and reutilized without scrapping.

According to this invention, there is provided a free-standing vehicle parking structure adapted to be placed on a substantially flat surface to provide a plurality of three-dimensional parking places capable of receiving parked vehicles, said structure comprising a plurality of assembly elements, each element having a base plate to be placed on said surface and a pillar coupled to the base plate so as to extend upwardly from the base plate when said base plate is lying on said surface, whereby a vertical load applied to the upper end of that pillar is substantially borne by its associated base plate, the upper ends of the pillars of two adjacent assembly elements being connected together by a respective beam member and the lower ends of these pillars being connected together by a respective brace member, the connections between the upper ends of the pillars and the beam members, and the connections between the lower ends of the pillars and the brace members, being made in a releasable manner to enable disassembly of the structure, and the structure also including an inclined passageway assembly for enabling access of vehicles to an upper side of the structure defined by said plurality of assembly elements.



The invention is described further hereinafter, by way of example only, with reference to the accompanying drawings, in which:

Figure 1 is a front elevation showing one specific embodiment of a vehicle parking structure of the invention;

Figure 2 is a perspective view of the main body of the vehicle parking structure of Figure 1;

Figure 3 is a sectional view taken along line III-III of Figure 1;

Figure 4 is a top plan view taken along line IV-IV in Figure 1;

Figure 5 is a perspective view showing a first embodiment of the assembly element in the vehicle parking structure shown in Figure 1;

Figure 6 is a perspective view showing a second embodiment of the assembly element in the vehicle parking structure shown in Figure 1;

Figure 7 is a perspective view showing a third embodiment of the assembly element in the vehicle parking structure shown in Figure 1;

Figure 8 is a perspective view showing a fourth embodiment of the assembly element in the vehicle parking structure shown in Figure 1;

Figure 9 is a perspective view showing a fifth embodiment of the assembly element in the vehicle parking structure shown in Figure 1;

Figure 10 is a perspective view showing a sixth embodiment of the assembly element in the vehicle parking structure shown in Figure 1;

Figure 11 is a front elevation showing part of a modified example of the assembly element of the third embodiment;

Figure 12 is a perspective view showing the inclined passage assembly in the vehicle parking structure shown in Figure 1; and

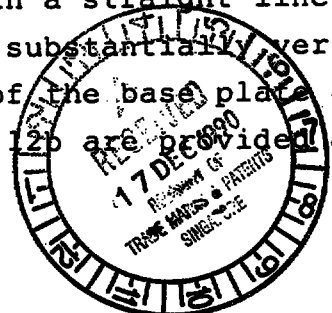
Figure 13 is a perspective view showing the individual inclined passage assembly elements of the inclined passage assembly shown in Figure 12.

One specific embodiment of a free-standing vehicle parking structure constructed in accordance with this invention will be described with reference to the accompanying drawings.

5 With reference to Figures 1 and 2, the illustrated vehicle parking structure has a main body shown generally at 2. The main body 2 can be conveniently utilized as a parking station for providing three-dimensional vehicle parking spaces as will be
10 described hereinafter, and in relation to this utility, an inclined passage assembly 4 is annexed to it.

With reference to Figures 3 and 4 also, the illustrated main body 2 of the structure is assembled in the form shown in Figures 1 to 4 by assembling several
15 kinds of assembly elements, but is basically comprised of three types of assembly elements shown in Figures 5 to 7.

As will be seen from Figures 2 to 4, an assembly element 6 of the first embodiment shown in Figure 5 is
20 used at the corner portions of the main body 2. The assembly element 6 has a substantially flat base plate 8 and a pillar 10 extending upwardly from the base plate 8. The base plate 8 can be made of, for example, a steel sheet having the shape of a nearly right-angled
25 equilateral triangle. The pillar 10 may be formed, for example, of a hollow steel post having a substantially rectangular cross-sectional shape. In the illustrated embodiment, the lower end of the pillar 10 is fixed by welding or otherwise to a specific right-angled corner
30 part of the base plate 8, and the other corner parts of the base plate 8 are chamfered in a straight line. The pillar 10 extends upwardly in a substantially vertical fashion from the upper surface of the base plate 8 and two connecting portions 12a and 12b are provided at the



upper end portion of the pillar 10. In the illustrated embodiment, the connecting portions 12a and 12b are fixed to the side surface of the pillar 10 by welding or otherwise, and each made up of a steel material having an H-shaped section. The portions 12a, 12b extend in a lateral direction which is substantially perpendicular to the axial direction of the pillar 10, and are spaced from each other substantially by an angle of 90 degrees. One connecting portion 12a extends laterally from one side surface of the pillar 10 and substantially parallel to one edge portion defining the aforesaid specific corner part of the base plate 8, and the other connecting portion 12b extends laterally from that side surface of the pillar 10 which is adjacent to the aforesaid one side surface, and substantially parallel to the other edge portion defining the specific corner part of the base plate.

Preferably, reinforcing members 14a and 14b and corresponding reinforcing members 16 are provided in the assembly element 6 as shown in Figure 5. The reinforcing members 14a and 14b may be formed of a steel material having a channel-shaped section. One reinforcing member 14a is disposed along the aforesaid one edge portion of the base plate 8 with its one end fixed to the pillar 10 and its open lower end fixed to the upper surface of the base plate 8. The other reinforcing member 14b is disposed along the aforesaid other edge portion of the base plate 8 with its one end fixed to the pillar 10 and its open lower end fixed to the upper surface of the base plate 8. The reinforcing members 16 are disposed correspondingly to the reinforcing members 14a and 14b (only one reinforcing member 16 is shown in Figure 5). The reinforcing members 16 are formed as substantially wedge-shaped steel elements. One reinforcing member 16 is disposed

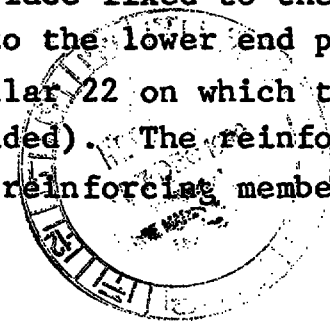
with its pointed one end facing upwards, its other end fixed to the upper surface of the reinforcing member 14a and its one side surface fixed to the pillar 10 (more specifically, to the lower end portion of that side surface of the pillar 10 at which the connecting portion 12a is provided). The other reinforcing member 16 (not shown) is disposed with its pointed one end facing upwards, its other end fixed to the upper surface of the reinforcing member 14b and its one side surface fixed to the pillar 10 (more specifically, to the lower end portion of the side surface of the pillar 10 at which the connecting portion 12b is provided). These reinforcing members 14a, 14b and 16 may also be fixed by welding or otherwise.

15 An assembly element 18 in accordance with the second embodiment shown in Figure 6 is used at the outside portion of the main body 2 of the structure excepting the aforesaid corner parts, as can be seen from Figures 2 to 4. The assembly element 18 has a substantially flat base plate 20 and a pillar 22 extending upwardly from the base plate 20. The illustrated base plate 20 is formed of a steel sheet in the shape of a nearly right-angled equilateral triangle (the area of the base plate 20 is nearly twice that of the base plate 8 of the assembly element 6 in the first embodiment). The pillar 22 is formed of a hollow steel post having a substantially rectangular cross-sectional shape. In the illustrated embodiment, the lower end of the pillar 22 is fixed to the central part of that edge portion of the base plate 20 which is opposite to a specific right-angled corner part thereof, and the three corner parts of the base plate 20 are chamfered in a straight line. The pillar 22 extends upwardly in a substantially vertical fashion from the upper surface of the base plate 20, and three connecting portions 24a,

24b and 24c are provided at its upper end portion. In the illustrated embodiment, the three connecting portions 24a, 24b and 24c are fixed respectively to the side surface of the pillar 22 and are made of a steel material having an H-shaped cross section. These connecting portions extend in a lateral direction substantially perpendicular to the axial direction of the pillar 22 and spaced from each other by an angle of 90 degrees. Specifically, the connecting portion 24a extends laterally from one side surface of the pillar 22 and substantially parallel to that edge portion of the base plate 20 which is opposite to the aforesaid specific corner part. The connecting portion 24b extends laterally from that side surface of the pillar 22 which is adjacent to the aforesaid one side surface, and substantially parallel to a direction substantially perpendicular to the edge portion of the base plate 20 opposite to the specific corner part. The connecting portion 24c extends laterally (therefore, in a direction substantially opposite to the connecting portion 24a) from that side surface of the pillar 22 which is opposite to the aforesaid one side surface, and substantially parallel to the edge portion of the base plate 20 opposite to the specific corner part.

Preferably, reinforcing members 26a, 26b and 26c and corresponding reinforcing members 28 are provided in the assembly element 18 as shown in Figure 6. The reinforcing members 26a, 26b and 26c correspond to the reinforcing members 14a and 14b in the assembly element 6 in accordance with the first embodiment, and may be formed of a steel material having a channel-shaped cross section. The reinforcing member 26a is disposed along that edge portion of the base plate 20 which is opposite to the specific corner part with its one end fixed to the pillar 22 and its open lower end fixed to

the upper surface of the base plate 20. The reinforcing member 26b is disposed in the central part of the base plate 20 in a direction substantially perpendicular to the edge portion of the base plate 20 opposite to the specific corner part. One end of the reinforcing member 26b is fixed to the pillar 22, and its open lower end is fixed to the upper surface of the base plate 20. The reinforcing member 26c is disposed opposite to the reinforcing member 26a along the edge portion of the base plate 20 opposite to the specific corner part with its one end fixed to the pillar 22 and its open lower end fixed to the upper surface of the base plate 20. On the other hand, the reinforcing members 28 correspond to the reinforcing members 16 in the assembly element 6 in the first embodiment. They are formed of a nearly wedge-shaped steel material and are disposed correspondingly to the reinforcing members 26a, 26b and 26c (in Figure 6, two reinforcing members 28 are shown), and fixed in the same way as in the case of the reinforcing members 16. Specifically, the reinforcing member 28 corresponding to the reinforcing member 26a is disposed with its lower end fixed to the upper surface of the reinforcing member 26a and its one side surface fixed to the pillar 22 (more specifically, to the lower end portion of that side surface of the pillar 22 on which the connecting portion 24a is provided). The reinforcing member 28 (not shown) corresponding to the reinforcing member 26b is disposed with its lower end fixed to the upper surface of the reinforcing member 26b and its one side surface fixed to the pillar 22 (more specifically, to the lower end portion of that side surface of the pillar 22 on which the connecting portion 24b is provided). The reinforcing member 28 corresponding to the reinforcing member 26c is

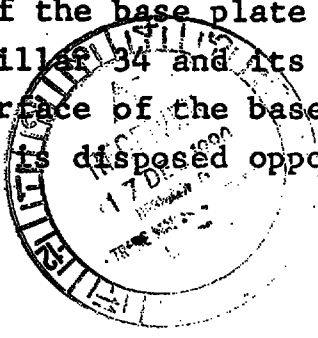


disposed with its lower end fixed to the upper surface of the reinforcing member 26c and its one side surface fixed to the pillar 22 (more specifically, to the lower end portion of that side surface of the pillar 22 on which the connecting portion 24c is provided). The various members in the assembly element 18 in the second embodiment may be fixed by welding or otherwise.

An assembly element 30 in the third embodiment shown in Figure 7 is used in the interior portion of the main body 2 of the structure, as can be understood from Figures 2 to 4. The assembly element 30 has a substantially flat base plate 32 and a pillar 34 extending upwardly from the base plate 32. The illustrated base plate 32 is formed of a nearly square steel sheet (the area of the base plate 32 is nearly four times that of the base plate 8 in the assembly element 6 in the first embodiment), and the pillar 34 is formed of a hollow steel post having a substantially rectangular cross-sectional shape. In the illustrated embodiment, the lower end of the pillar 34 is fixed to the substantially central portion of the base plate 32, and the four corner parts of the base plate 32 are chamfered in a straight line. The pillar 34 extends upwardly in a substantially vertical fashion from the upper surface of the base plate 32, and four connecting portions 36a, 36b, 36c and 36d are provided at the upper end portion of the pillar 34. In the illustrated embodiments, the four connecting portions 36a, 36b, 36c and 36d are fixed to the side surfaces of the pillar 34, and are formed of a steel material having an H-shaped cross section. The four connecting portions extend in a lateral direction which is substantially perpendicular to the axial direction of the pillar 34, and are spaced from each other by an angle of 90 degrees. Specifically, the connecting portion 36a extends laterally from one side

surface of the pillar 34 and substantially parallel to one diagonal line of the base plate 32. The connecting portion 36b extends laterally from one side surface of the pillar 34 which is adjacent to the aforesaid one side surface, and substantially parallel to the other diagonal line of the base plate 32. The connecting portion 36c extends laterally (therefore, in a direction substantially opposite to the connecting portion 36a) from that side surface of the pillar 34 which is opposite to the aforesaid one side surface, and substantially parallel to the aforesaid one diagonal line of the base plate 32. The connecting portion 36d extends laterally (therefore, in a direction substantially opposite to the connecting portion 36b) from the other side surface of the pillar 34 adjacent to the aforesaid one side surface and substantially parallel to the aforesaid other diagonal line of the base plate 32.

Preferably, reinforcing members 38a, 38b, 38c and 38d and corresponding reinforcing members 40 are provided in the assembly element 30 as shown in Figure 7. The reinforcing members 38a to 38d correspond to the reinforcing members 14a and 14d in the assembly element 6 in the first embodiment. The reinforcing members 38a, 38c and 38d are each formed of a nearly wedge-shaped steel material, and the reinforcing member 38b, of a steel material having a channel-shaped cross-section. The reinforcing member 38a is disposed along the aforesaid one diagonal line of the base plate 32 with its one end fixed to the pillar 34 and its lower end fixed to the upper surface of the base plate 32. The reinforcing member 38b is disposed along the other diagonal line of the base plate 32 with its one end fixed to the pillar 34 and its open lower end fixed to the upper surface of the base plate 32. The reinforcing member 38c is disposed opposite

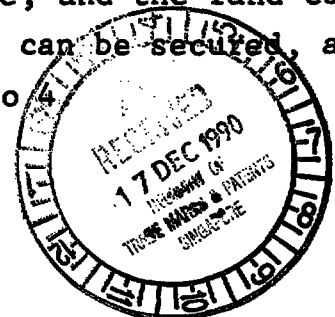


to the reinforcing member 38a along the aforesaid one diagonal line of the base plate 32 with its one end fixed to the pillar 34 and its lower end fixed to the upper surface of the base plate 32. The reinforcing member 38d is disposed opposite to the reinforcing member 38b along the aforesaid other diagonal line of the base plate 32 with its one end fixed to the pillar 34 and its lower end fixed to the upper surface of the base plate 32. The reinforcing members 40 correspond to the reinforcing members 16 in the assembly element 6 in the first embodiment. They are formed of a nearly wedge-shaped steel material and disposed correspondingly to the reinforcing members 38a to 38d (three reinforcing members 40 are shown in Figure 7). The reinforcing members 40 are fixed in the same way as in the case of the reinforcing members 16. Specifically, the reinforcing member 40 corresponding to the reinforcing member 38a is fixed at its lower end to the upper surface of the reinforcing member 38a and at its one side surface to the pillar 34 (more specifically, to the lower end portion of that side surface of the pillar 34 on which the connecting portion 36a is provided). The reinforcing member 40 (not shown) corresponding to the reinforcing member 38b is fixed at its lower end to the upper surface of the reinforcing member 38b and at its one side surface to the pillar 34 (more specifically, to the lower end portion of that side surface of the pillar 34 on which the connecting portion 36b is provided). The reinforcing member 40 corresponding to the reinforcing member 38c is fixed at its lower end to the upper surface of the reinforcing member 38c and at its one side surface to the pillar 34 (more specifically, to the lower end portion of that side surface of the pillar 34 on which the connecting portion 36c is provided). The reinforcing member 40 corresponding to

the reinforcing member 38d is fixed at its lower end to the upper surface of the reinforcing member 38d and at its one side surface to the pillar 34 (more specifically, to the lower end portion of that side surface of the pillar 34 on which the connecting portion 36d is provided). The various members in the assembly element 30 in the third embodiment can also be fixed by welding or otherwise.

The reinforcing members 14a and 14b, 26a to 26c and 38a to 38d in the assembly elements 6, 18 and 30 mainly act against vertical loads (loads in the axial direction of the pillars) acting on the pillars 10, 22 and 34. The reinforcing members 16, 28 and 40 act mainly against lateral loads (loads acting in a direction perpendicular to the axial direction of the pillar) acting on the pillars 10, 22 and 34. Hence, when the strength of the assembly element is sufficient with regard to vertical loads, the reinforcing members 14a and 14b, 26a to 26c and 38a to 38d may be partly or wholly omitted. Furthermore, when the assembly element has sufficient strength against lateral loads, the reinforcing members 16, 28 and 40 may be partly or wholly omitted.

The base plates 8, 20 and 32 in the assembly elements 6, 18 and 30 need not necessarily be of the aforesaid shapes, and may be of any other suitable shape which can sufficiently support vertical loads acting on the pillars 10, 22 and 34. However, when the assembly elements (particularly the assembly elements 6 and 18) are of the aforesaid shapes, the base plates 8 and 20 do not partly project outwardly of the main body 2 of the structure, and the land can be effectively utilized and safety can be secured, as can be understood from Figures 2 to



As will be understood from the following description, a parking structure in accordance with this invention is constructed basically of combinations of the assembly elements 6, 18 and 30 in the first to third embodiments shown in Figures 5 to 7, connected together by upper and lower beams and braces as described hereinafter. In addition to, or in place of these, assembly elements resulting from suitable combinations of the assembly elements 6, 18 and 30 in the first to third embodiments may also be used.

Now, with reference to Figures 8 to 10, modified embodiments of the assembly elements will be described. For easy understanding, in Figures 8 to 10, substantially the same members as those shown in Figures 5 to 7 are designated by the same reference numerals as in Figures 5 to 7.

With reference to Figure 8, an assembly element 42 in the fourth embodiment is constructed by combining the assembly element 6 in the first embodiment shown in Figure 5 and the assembly element 18 in the second embodiment shown in Figure 6. As will be described later, the upper portions of the assembly elements 6 and 18 are connected to each other detachably via a beam member and their lower end portions are connected detachably via a brace member. In the assembly element 42 in the fourth embodiment, these connecting members are fixed between the two assembly elements to form an integral unit. Specifically, the assembly element 42 has a base plate 8, a pillar 10 extending upwardly from the base plate 8, a base plate 20, and a pillar 22 extending upwardly from the base plate 20. One end of a beam member 44 is fixed to the upper end portion of the pillar 10 and the other end of the beam member 44, to the upper end portion of the pillar 22. Furthermore, one end of a brace member 46 is fixed to the lower end portion of the pillar 10, and the other end of the brace

member 46, to the lower end portion of the pillar 22. Correspondingly to the brace member 46, reinforcing members 16 and 28 (only one of the two reinforcing members 16 and two of the three reinforcing members 28 are shown in Figure 8) are disposed in the same way as in the case of reinforcing members 14a, 26b and 26c. In other words, as can be easily understood from a comparison of Figures 5 and 6 with Figure 8, the assembly element 42 in the fourth embodiment is constructed by connecting the assembly element 6 shown in Figure 5 and the assembly element 18 shown in Figure 6 via the beam member 44 instead of providing the connecting portions 12b and 24a and also via the brace member 46 instead of providing the reinforcing members 14b and 26a.

An assembly element 48 in the fifth embodiment shown in Figure 9 is constructed by combining the assembly element 18 in the second embodiment shown in Figure 6 and the assembly element 30 in the third embodiment shown in Figure 7. Specifically, the upper end portions of the assembly elements 18 and 30 are connected to each other detachably via a beam member and their lower end portions are connected detachably via a brace member. In the assembly element 48 in the fifth embodiment, as in the case of the assembly element 42 in the fourth embodiment, these connecting members are fixed between the two assembly elements to form an integral unit. More specifically, the assembly element 48 has a base plate 20, a pillar 22 extending upwardly from the base plate 20, a base plate 32, and a pillar 34 extending upwardly from the base plate 32. One end of a beam member 50 is fixed to the upper end portion of the pillar 22, and the other end thereof to the upper end portion of the pillar 34. Furthermore, one end of a brace member 52 is fixed to the lower end portion of the pillar 22, and its other end, to the lower end portion

of the pillar 34. Correspondingly to the brace member 52, reinforcing members 28 and 40 (two of the three reinforcing members 28 and three of the four reinforcing members 40 are shown in Figure 9), like reinforcing members 26a, 26c, 38a, 38b and 38c, are disposed. In other words, as can be easily understood from a comparison of Figures 6 and 7 with Figure 9, the assembly element 48 in the fifth embodiment is constructed by connecting the assembly element 18 shown in Figure 6 and the assembly element 30 shown in Figure 7 to each other via the beam member 50 instead of providing the connecting portions 24b and 36d and also via the brace member 52 instead of providing the reinforcing members 26b and 38d.

15 An assembly element 54 in the fifth embodiment shown in Figure 10 is constructed by combining the assembly element 6 in the first embodiment shown in Figure 5 and the assembly element 18 in the second embodiment shown in Figure 6 nearly as in the assembly element 42 in the fourth embodiment shown in Figure 8. As can be easily understood from a comparison of Figures 5 and 6 with Figure 10 (and more easily from a comparison of Figure 8 with Figure 10), the assembly element 54 in the sixth embodiment is constructed by connecting the assembly element 6 shown in Figure 5 and the assembly element 18 shown in Figure 6 to each other via a beam member 56 instead of providing the connecting portions 12a and 24c and also via a brace member 58 instead of providing the reinforcing members 14a and 26c.

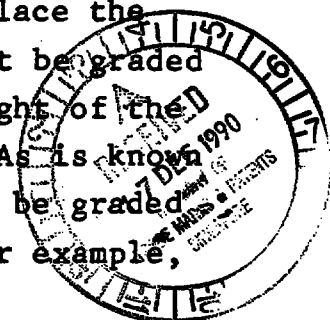
30 As required, an assembly element of a seventh embodiment (not shown) constructed by combining two assembly elements 30 in the third embodiment shown in Figure 7 may also be used. The assembly element in the seventh embodiment can be constructed by connecting two

assembly elements 30 shown in Figure 7 to each other via a beam member instead of providing the connecting portion 36a (or 36b, 36c, or 36d) in one of them and the connecting portion 36a (or 36b, 36c or 36d) in the other and also via a brace member instead of providing the reinforcing member 38a, (or 38b, 38c or 38d) in one of the elements and the reinforcing member 38a (or 38b, 38c or 38d) in the other.

The beam members 44, 50 and 56 and the brace members 46, 52 and 58 may also be fixed in place by welding or otherwise, in order to connect, for example, pillars 10,22,10 and pillars 22,34,22 of the assembly elements 42,48,54. In the illustrated embodiments, the beam members 44,50 and 56 are formed of a steel material having an H-shaped section (substantially the same as the various connecting portions), and the brace members 46,52 and 58 may be formed of a steel material having a channel-shaped section.

When the assembly elements 42,48 and 54 shown in Figures 8 to 10 are used instead of the assembly elements 6, 18 and 30 shown in Figures 5 to 7, the assembly elements become large in size and some trouble occurs in transportation, for example. However, this brings about the advantage that these elements can be assembled and disassembled in the field within a short period of time.

The main body 2 of the structure can be built up by connecting the various assembly elements described hereinabove in such a way that they are able to be disassembled. With reference to Figures 2 to 4, the assembly elements are positioned in place as shown in Figures 2 to 4. When the land on which to place the main body 2 of the structure is soft, it must be graded so as to make it fully withstand the own weight of the main body 2 and loads to be exerted on it. As is known to those skilled in the art, the land should be graded by lime treatment and levelling pavement, for example,



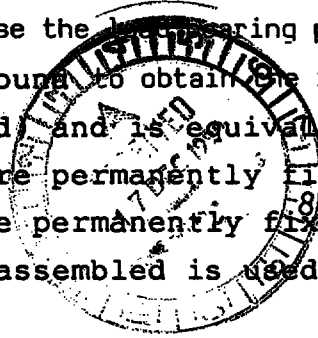
to prepare a substantially flat ground surface with the required strength.

Then, at one corner part of the main body 2, for example, the left top end in Figures 2 to 4, the
5 assembly element 6 is connected to the adjoining assembly element 18, and in this manner, the elements are connected to each other successively to form a structure having the form shown in Figures 2 to 4. For example, the assembly elements 6 and 18, as are the
10 other assembly elements, are disassembably connected to each other via a beam member 60 between their upper end portions and via a brace member 62 between their lower end portions. For example, in the case of the assembly elements 6 and 18 positioned at the left top in Figures 2 to 4, the
15 connecting portion 12a of the assembly element 6 is connected to one end portion of the beam member 60 via a connecting plate (not shown) (more specifically by connecting one end portion of the connecting plate to the connecting portion 12a of the assembly element 6 by
20 means of a plurality of bolts and nuts and at the same time, connecting its other end portion to one end portion of the beam member 60 by means of a plurality of bolts and nuts). At the same time, the connecting portion 24c of the assembly element 18 is connected to
25 the other end portion of the beam member 60 via connecting plate (not shown) (more specifically, by connecting one end portion of the connecting plate to the connecting portion 24c of the assembly element 18 by means of a plurality of bolts and nuts and its other end
30 portion to the other end portion of the beam member 60 by a plurality of bolts and nuts). Furthermore, the reinforcing member 14a of the assembly element 6 is directly connected to one end portion of the brace member 62 by means of a plurality of bolts and nuts, and
35 the reinforcing member 26c of the assembly element 18

is directly connected to the other end portion of the
brace member 62 by means of a plurality of bolts and
nuts. In the illustrated embodiments, all the beam
members 60 in Figures 2 to 4 are connected disassembably
5 to the corresponding assembly elements, and all the
brace members 62 in Figures 2 and 3 are connected to the
corresponding assembly elements in a disassemblable
manner. As can be understood from Figures 7 to 10, both
end portions of each of the brace members 64 in Figures
10 2 and 3 are disassembably connected directly to the base
plates of the corresponding assembly elements by means
of bolts and nuts.

Thereafter, a plurality of upper plates 66 (partly
shown by a two-dot chain in Figure 4) of a suitable size
15 are placed on the upper surface defined by the various
assembly elements 6, 18, 30, 42, 48 and 54, and connected
disassembably to these assembly elements by, for
example, bolts and nuts.

As a result, the main body 2 of the structure
20 shown in Figures 1 to 4 is assembled and placed on a
prepared ground surface. The main body 2 of the
structure, as can be understood from Figures 2 and 3, is
in the shape of a relatively low-storied hollow box, and
has a relatively large installation area and a large
25 weight. Accordingly, it has a structural strength
enough to overcome various conditions such as stress to
bear external force by the fixed load by the own weight
of the main body 2 of the structure and bearing power of
the ground of the installation area (when the ground is
30 soft, it is necessary to increase the bearing power of the
ground by improving the ground to obtain the required load
bearing power of the ground, and is equivalent to a
conventional built structure permanently fixed to the
ground even if it cannot be permanently fixed to the
35 ground. The structure so assembled is used especially



conveniently as a two-storied parking place utilizing the spaces effectively.

As shown in Figures 2 and 3, pillars 22 and 34 facing passage areas existing among parking areas (shown by broken lines in Figures 2 and 3) are positioned slightly rearwardly of the front ends of the parking areas. This structure permits easy incoming and outgoing of vehicles.

In the main body 2 of the structure described above, vertical loads acting on the pillars 10, 22 and 30 of the assembly elements 6, 18, 30, 42, 48 and 54 are substantially borne by the base plates 8, 20 and 32. Accordingly, the structure needs not to be fixed to the ground as is the case with the prior art. This enables the main body 2 of the structure to be assembled and disassembled and re-utilized without scrapping.

In the illustrated embodiments, the main body 2 of the structure is assembled by using the assembly elements 6, 18 and 30 shown in Figures 5 to 7 at the upper portion in Figures 2 to 4, and the assembly elements 42, 48 and 54 shown in Figures 8 to 10 at the lower portion in Figures 2 to 4. This is not essential, and it may be assembled by suitably combining these assembly elements. For example, the whole main body 2 of structure may be assembled by using the assembly elements 6, 18 and 30 shown in Figures 5 to 7. Alternatively, the whole main body 2 may be assembled by using the assembly elements 42, 48 and 54 shown in Figures 8 to 10.

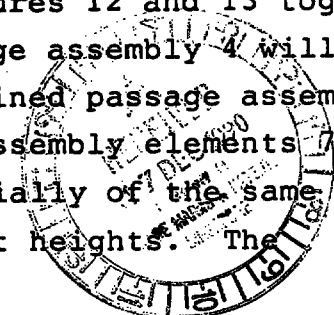
In the illustrated embodiments, the main body 2 of the structure is substantially rectangular when viewed from above. This is not limitative, and it may be constructed in various desired shapes corresponding to the shape of the land by suitably selecting the combinations of the assembly elements 6, 18 and 30.

As required, an auxiliary beam member may be detachably connected to opposing beam members 60 to increase strength.

In principle, the main body 2 of the structure is constructed by connecting the assembly elements 6, 18 and 30. But it may also be constructed by connecting a plurality of assembly elements 30 via the beam members 60 and brace members 64, although in this case, some of the connecting portions will project out of the structure.

Preferably, a sheet-like member formed, for example, of a rubber material is attached to the lower surfaces (the ground-contacting surfaces) of the base plates 8, 20 and 32 in the assembly elements 6, 18, 30, 42, 48 and 54 described above. One example is shown in Figure 11 which indicates a modified example of the assembly element 30 shown in Figure 7. A sheet-like member 68 made, for example, from a synthetic rubber is fixed to the substantially entire area of the lower surface of the base plate 32 of an assembly element 30' by an adhesive, for example. This structure results in an increased friction between the base plate 32 and the ground surface, and can prevent slippage of the assembly element 30' and increase its stability. At the same time, this permits corrosion inhibition of the base plate 32 of the assembly element 30'. Furthermore, in the event that a shock is applied to the main body 2 of the structure (for example, by earthquake), the sheet-like member can effectively absorb the shock.

Now, with reference to Figures 12 and 13 together with Figure 1, an inclined passage assembly 4 will be described. The illustrated inclined passage assembly 4 includes five inclined passage assembly elements 72, 74, 76, 78 and 80 which are substantially of the same structure except having different heights. The



structure of the inclined passage assembly element 72 (74, 76, 78, 80) will be described in detail with reference mainly to Figure 13.

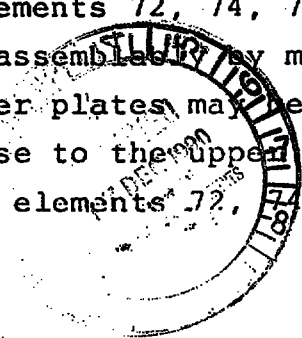
The inclined passage assembly elements 72 (74, 76, 78 and 80) have lower frame members 72a (74a, 76a, 78a, and 80a) defining a substantially flat under surface and upper frame members 72b (74b, 76b, 78b, and 80b) defining a substantially flat upper surface, respectively. The lower frame members 72a (74a, 76a, 78a, and 80a) in the illustrated embodiment are constructed by connecting four steel members having a channel-shaped section in a rectangular form. The upper frame members 72b (74b, 76b, 78b and 80b) are constructed by connecting four steel members having a channel-shaped section in a rectangular form. The lower frame members 72a (74a, 76a and 78a) are connected to the upper frame members 72b (74b, 76b, and 78b) via four connecting members 72c (74c, 76c and 78c). Specifically, the lower ends of the connecting members 72c (74c, 76c and 78c) are fixed to the four corner parts of the lower frame members 72a (74a, 76a and 78a), and the upper ends of the connecting members 72c (74c, 76c and 78c) are fixed to the four corner parts of the upper frame members 72b (74b, 76b and 78b). Two of the four connecting members 72c (74c, 76c, and 78c) are larger in length than the remaining two. Hence, the upper surfaces of the upper frame members 72b (74b, 76b and 78b) form an inclined surface. In the inclined passage assembly element 80, one end of the lower frame member 80a is connected to one end of the upper frame member 80b by two relatively short connecting members 80c, and their other ends are directly connected, as shown in Figure 13. As a result, the upper surface of the upper frame member 80b defines an inclined surface. Preferably, in the inclined passage assembly

elements 72 (74, 76, 78 and 80), bottom plates 72d (74d, 76d, 78d and 80d) are provided for bearing the weights of the assembly elements themselves and loads acting thereon. In the illustrated embodiment, each of the
5 bottom plates 72d (74d, 76d, 78d, and 80d) is formed of a steel sheet in the shape of a nearly right-angled triangle, and is fixed to the under surfaces of the four corner parts of each of the lower frame members 72a (74a, 76a, 78a, and 80a).

10 The various members of the inclined passage assembly elements 72 (74, 76, 78 and 80) can be fixed by welding or otherwise.

The inclined passage assembly 4 may be built up, for example, by disassemblably connecting the inclined
15 passage assembly elements 72 (74, 76, 78, and 80) after assembling the main body 2 of the structure.

Specifically, the inclined passage assembly elements are positioned in place as shown in Figures 1, 2 and 12, and then the adjoining inclined passage assembly elements
20 are connected to each other. For example, the inclined passage assembly element 72 may be disassemblably connected to the inclined passage assembly element 74 by applying bolts and nuts to the adjoining parts of the two elements. Connection of the other inclined passage
25 assembly elements can be achieved in the same way. When the assembly elements 72, 74, 76, 78 and 80 are connected properly, the inclined passage assembly 4 of the form shown in Figure 2 is built up. Thereafter, an upper plate (not shown) that can be formed of a steel
30 sheet, for example, is placed on the upper surfaces of the inclined passage assembly elements 72, 74, 76, 78 and 80 and connected thereto disassemblably by means of bolts and nuts. If desired, upper plates may be fixed in advance by welding or otherwise to the upper surfaces
35 of the inclined passage assembly elements 72, 74, 76, 78



and 80. As a result, the inclined passage assembly 4 shown in Figure 1 is placed on the prepared ground surface. In this inclined passage assembly 4, the upper plates (not shown) define a substantially continuous inclined surface and function to conduct a vehicle to the upper plates 66 of the main body 2 of the structure (and therefore, to an outdoor parking place).

In the illustrated embodiments, the inclined passage assembly is annexed, for example, between the pillar 22 of the assembly element 18 and the pillar 22 of the assembly element 54 at the right end portion (the right end portion in Figure 2) of the main body 2 of the structure. Hence, in the illustrated structure, the portion between the pillar 22 of the assembly element 18 and the pillar 22 of the assembly element 42 in the left end portion of the main body 2 serves as an entrance and an exit for the first floor of the parking structure, and the inclined passage assembly 4 annexed to the right end portion of the main body 2 serves as an entrance and an exit for the second floor of the parking structure. The inclined passage assembly 4 may be set up at any desired site in relation to the shape, etc. of the main body 2 of the structure.

Preferably, the above structure is constructed as described below in order that it functions properly and conveniently as a parking place.

With the reference to Figure 3, the brace members 62 and 64 connected to, and across, the lower end portions of the pillars of the assembly elements act as a reinforcement against shocks and impacts which may be generated in the event that a vehicle collides with the pillars. Since the brace members 64 are disposed at sites where vehicles pass, they preferably have a relatively small thickness so as not to hamper passing and parking of vehicles. On the other hand, since the

brace members 62 are disposed at sites where vehicles do not pass or it is necessary to hamper passage of vehicles, they preferably have a relatively large thickness so as to hamper passing of vehicles. Particularly, in the
5 brace members in the outside portion of the main body 2 of the structure, the above function is especially required to prevent overrunning of vehicles out of the structure.

Since the second floor is also utilized as a
10 parking space, it is preferred for the sake of safety to provide a safety fence (not shown) for preventing falling of vehicles out of the structure in the peripheral portion of the structure excepting the entrance and exit. Such a safety fence may also be
15 provided on both side portions on the upper surface of the inclined passage assembly 4.

While one embodiment of the place-on type assemblable structure constructed in accordance with this invention has been described with regard to its use as a
20 parking place, it should be understood that the invention is not limited to this specific embodiment, and can also be applied to other uses such as a warehouse.

Example

25 A free-standing vehicle parking structure of the form shown in Figures 1 to 4 was utilized as a parking station accommodating 18 vehicles. The required strength was obtained by using various elements having the following sizes. The following are average examples of
30 application, and may slightly differ depending upon the texture, shape, etc. of the land.

Assembly elements of the first embodiment

Base plate: steel sheet, 19 mm thick

Area of the bottom of the base plate: 0.68 m^2

35 Pillar: Steel pillar having a size of 200 mm $\times$ 200 mm

Thickness of each side wall of the pillar: 8mm

Length of the pillar: 2.4 m

Assembly elements of the second embodiment

Base plate: steel sheet, 19mm thick

- 5 Area of the bottom of the base plate: 1.16 m^2

Pillar: steel pillar having a size of 200 mm x 200 mm

Thickness of each side wall of the pillar: 8 mm

Length of the pillar: 2.4 m

Assembly elements of the third embodiment

- 10 Base plate: steel sheet, 19mm thick

Area of the bottom of the base plate: 1.96 m^2

Pillar: steel pillar having a size of 200 mm x 200 mm

Thickness of each side wall of the pillar: 12 mm

- 15 Length of the pillar: 2.4 m

Other elements

Brace members that permit passage of vehicles: steel
sheet having a thickness of 19 mm and a width of
150 mm

- 20 Brace members hampering passage of vehicles: steel
material having a width of 180 mm, a height
of 75 mm and a thickness of 7 mm

Beam members: steel material having a height of 290 mm
and a width of 200 mm



CLAIMS

1. A free-standing vehicle parking structure adapted to be placed on a substantially flat surface to provide a plurality of three-dimensional parking places capable of receiving parked vehicles, said structure comprising a plurality of assembly elements, each element having a base plate to be placed on said surface and a pillar coupled to the base plate so as to extend upwardly from the base plate when said base plate is lying on said surface, whereby a vertical load applied to the upper end of that pillar is substantially borne by its associated base plate, the upper ends of the pillars of two adjacent assembly elements being connected together by a respective beam member and the lower ends of these pillars being connected together by a respective brace member, the connections between the upper ends of the pillars and the beam members, and the connections between the lower ends of the pillars and the brace members, being made in a releasable manner to enable disassembly of the structure, and the structure also including an inclined passageway assembly for enabling access of vehicles to an upper side of the structure defined by said plurality of assembly elements.

2. A structure as claimed in claim 1, wherein a reinforcing member is provided in a connecting region where the pillar is connected to the base plate.

3. A structure as claimed in claim 1 or 2, wherein a sheet-like member formed of a rubbery material is provided on the bottom surface of the base plate which makes contact with the substantially flat surface.

4. A structure as claimed in claim 1, 2 or 3, wherein the pillar extends substantially perpendicularly to the base plate.

5. A structure as claimed in claim 1, 2, 3 or 4, wherein two connecting portions are provided at an upper end of the pillar, the two connecting portions extending in a lateral direction substantially perpendicular to the axial direction of the pillar and being spaced from each other substantially by an angle of 90 degrees.



6. A structure as claimed in claim 1, 2, 3 or 4, wherein three connecting portions are provided at an upper end portion of the pillar, the three connecting portions extending in a lateral direction substantially perpendicular to the axial direction of the pillar and being spaced from each other substantially by an angle of 90 degrees.

7. A structure as claimed in claim 1, 2, 3 or 4, wherein four connecting portions are provided at an upper end portion of the pillar, the four connecting portions extending in a lateral direction substantially perpendicular to the axial direction of the pillar and being spaced from each other substantially by an angle of 90 degrees.

8. A structure as claimed in claim 1, wherein one connecting portion is provided at an upper end portion of one pillar and two connecting portions are provided at an upper end portion of the pillar of the adjacent element, the connecting portion provided in said one pillar extending in a lateral direction substantially perpendicular to the axial direction of the pillar and being spaced from the associated beam member substantially by an angle of 90 degrees in a predetermined direction, and the two connecting portions provided at the other pillar extend in a lateral direction substantially perpendicular to the axial direction of the other pillar and are spaced from the associated beam member substantially by an angle of 90 and 180 degrees in a direction opposite to said predetermined direction.

9. A structure as claimed in claim 1, wherein two connecting portions are provided at an upper end portion of the pillar of one element and three connecting portions are provided at the upper end portion of the pillar of the adjacent element, the two



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connecting portions provided at said one pillar extending in a lateral direction substantially perpendicular to the axial direction of said pillar and being spaced from the associated beam member substantially by an angle of 90 degrees in a predetermined direction and in a direction opposite to said predetermined direction, and the three connecting portions provided at the other pillar extending in a lateral direction substantially perpendicular to the axial direction of that pillar and being spaced from the associated beam member substantially by an angle of 90, 180 and 270 degrees in a direction opposite to said predetermined direction.

10. A structure as claimed in claim 1, wherein three connecting portions are provided at the upper end portions of each of two of the pillars, the three connecting portions provided on one pillar extending in a lateral direction substantially perpendicular to the axial direction of said one pillar and being spaced from the associated beam member substantially by an angle of 90, 180 and 270 degrees in a predetermined direction, and the three connecting portions provided on the other pillar extending in a lateral direction substantially perpendicular to the axial direction of that pillar and being spaced from the associated beam member substantially by an angle of 90, 180 and 270 degrees in a direction opposite to said predetermined direction.

11. A structure as claimed in claim 1, wherein the inclined passage assembly comprises a plurality of inclined passage assembly elements, each of the





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assembly elements having a bottom plate for substantially bearing a vertical load acting therein.

12. A structure as claimed in claim 11, wherein each of said inclined passage assembly elements includes a lower frame member defining a substantially flat lower surface and an upper frame member defining a substantially flat inclined upper surface, said bottom plate being provided on the lower frame member.

13. A free-standing, vehicle parking structure substantially as hereinbefore described with reference to and as illustrated in the accompanying drawings.
