

DESCRIPTION

PRECAST CONCRETE MEMBER

Technical Field

[0001] The present disclosure relates to a precast concrete member.

Background Art

[0002] Japanese Patent Application Laid-Open (JP-A) No. 2018-178365 discloses a joint coupler for quickly and reliably joining beam main reinforcement during on-site work to join together precast concrete members. The joint coupler is formed in a circular tube shape with two different external diameters, the smaller diameter portion being formed with a female thread portion. Joint reinforcement is screwed together with the female thread portion.

SUMMARY OF INVENTION

Technical Problem

[0003] The joint coupler disclosed in JP-A No. 2018-178365 is formed with a larger diameter portion, the smaller diameter portion, the female thread portion, and so on.

Mechanical couplings such as this joint coupler have shapes that make them difficult to form by extrusion molding or press molding, and moreover require a specific strength. Such mechanical couplings are therefore generally manufactured by casting.

[0004] Only one type of molded article can be manufactured by any given mold. Thus, plural types of mold need to be manufactured according to the diameter of the joint reinforcement. Moreover, high-level casting technology is required in order to secure dimensional precision and the required strength.

[0005] It is therefore difficult to manufacture such mechanical coupling in small batches, and it is difficult to adapt to the specific needs at each construction site. It is also difficult for a customer to secure a stable and affordable supply of mechanical couplings with at least a certain level of quality.

[0006] In consideration of the above circumstances, the present disclosure provides a precast concrete member capable of securing rebar coupling strength without employing a mechanical coupling.

Solution to Problem

[0007] A precast concrete member of a first aspect includes a main rebar that is embedded in precast concrete, a tubular sheath that is embedded in the precast concrete alongside the main rebar and into which a coupling main rebar is inserted and fixed, and a reinforcing tie that encircles the tubular sheath and the main rebar and that is assembled with the tubular sheath.

[0008] In the precast concrete member of the first aspect, the tubular sheath is embedded alongside the main rebar embedded in the precast concrete. An overlapping coupling between the coupling main rebar and the main rebar is configured by inserting and fixing the coupling main rebar in the tubular sheath.

[0009] The strength of the overlapping coupling may be determined by the cohesion strength between an outer peripheral face of the tubular sheath and the concrete. In the present aspect, the ring-shaped reinforcing tie that encircles the tubular sheath and the main rebar is integrated with the tubular sheath. This enables the cohesion strength to be improved, and enables the length of the overlapping coupling to be shortened. Moreover, the strength of the coupling can be secured.

[0010] This enables the rebar coupling strength to be secured without employing a mechanical coupling.

[0011] A precast concrete member of a second aspect is the precast concrete member of the first aspect, wherein a groove with which the reinforcing tie, which is ring-shaped, engages is formed in an outer peripheral face of the tubular sheath.

[0012] In the precast concrete member of the second aspect, the reinforcing tie engages with the groove formed in the outer peripheral face of the tubular sheath, and is thus integrated with the tubular sheath. This facilitates the operation of fitting the reinforcing tie in comparison to a configuration in which the reinforcing tie and the tubular sheath are integrated by welding.

[0013] A precast concrete member of a second aspect is the precast concrete member of the first aspect or the second aspect, wherein the precast concrete is a column member and hoop ties are arranged between the reinforcing ties.

[0014] In the precast concrete member of the third aspect, the hoop ties and the reinforcing ties do not impinge on each other. The reinforcing ties are therefore not liable to get in the way during an operation to provide the hoop ties.

Advantageous Effects of Invention

[0015] The present disclosure is capable of securing rebar coupling strength without employing a mechanical coupling.

BRIEF DESCRIPTION OF DRAWINGS

[0016] Fig. 1A is a vertical cross-section illustrating an example of a precast concrete member according to an exemplary embodiment of the present disclosure.

Fig. 1B is a cross-section along line B-B in Fig. 1A.

Fig. 2 is a vertical cross-section illustrating a join structure of a precast concrete

member according to an exemplary embodiment of the present disclosure.

Fig. 3A is a vertical cross-section illustrating a state in which a beam member is being lowered onto a column member from above in a precast concrete member joining method according to an exemplary embodiment of the present disclosure.

Fig. 3B is a vertical cross-section illustrating a state in which a column member is being lowered onto a beam member from above in a precast concrete member joining method according to an exemplary embodiment of the present disclosure.

Fig. 4 is a perspective view illustrating a tubular sheath and reinforcing ties of a precast concrete member according to an exemplary embodiment of the present disclosure.

Fig. 5 is a vertical cross-section illustrating a modified example in which reinforcing ties are disposed at a variable pitch in a precast concrete member according to an exemplary embodiment of the present disclosure.

Fig. 6 is a vertical cross-section illustrating a modified example in which outer peripheral faces of tubular sheaths are formed with a concertina profile in a precast concrete member according to an exemplary embodiment of the present disclosure.

Fig. 7 is a vertical cross-section illustrating a modified example in which reinforcing ties are formed in helical shapes in a precast concrete member according to an exemplary embodiment of the present disclosure.

Fig. 8 is a vertical cross-section illustrating a modified example in which a reverse spearing process is applied as a precast concrete member joining method according to an exemplary embodiment of the present disclosure.

DESCRIPTION OF EMBODIMENTS

[0017] Explanation follows regarding a precast concrete member according to an exemplary embodiment of the present disclosure, with reference to the drawings. Configuration elements indicated by the same reference numerals in the respective drawings correspond to the same configuration element. Unless specifically stated otherwise, in the present specification no configuration element is limited to a singular element, and plural thereof may be present. Moreover, explanation regarding configuration and reference numerals that appear multiple times in the drawings may be omitted. Note that the present disclosure is not limited to the exemplary embodiment below, and configurations may be omitted, replaced by another configuration, or otherwise modified as appropriate within a range corresponding to the object of the present disclosure.

[0018] Precast Concrete Member

Fig. 1A illustrates a column member 20. The column member 20 is a precast

concrete member that is cast in a factory before being transported to a construction site. The column member 20 is an example of a precast concrete member of the present disclosure.

[0019] Main rebar 22, hoop ties 24, tubular sheaths 30, and reinforcing ties 40 are embedded in the column member 20.

[0020] The main rebar 22 is configured by main column bars laid inside the column member 20 in an axial direction of the column member 20 (in a direction aligned with the single-dotted dashed line CL). Plural bars of the main rebar 22 are embedded in the column member 20 at a predetermined pitch about an outer peripheral face of the column member 20.

[0021] One end portion 22E of each bar of the main rebar 22 projects out from one end face of the column member 20. Another end portion 22F of each bar of the main rebar 22 forms an overlapping coupling G with coupling main rebar 22A, described later. In order to form the overlapping coupling G, the main rebar 22 is formed including a bent portion 22C, such that the end portion 22F is disposed further toward the inner side of the column member 20 than the end portion 22E.

[0022] As viewed along the axial direction of the column member 20, each of the hoop ties 24 is a shear-reinforcing tie encircling the main rebar 22. Plural of the hoop ties 24 are arranged at a predetermined pitch P1 along the axial direction of the column member 20. As illustrated in Fig. 1B, the hoop ties 24 are also arranged around the tubular sheaths 30 at a section forming the overlapping coupling G.

[0023] As illustrated in Fig. 1A, each of the tubular sheaths 30 is a tubular pipe body and is, for example, formed from hot-dip galvanized sheet steel. The tubular sheaths 30 are embedded in the column member 20, and open onto another end face (the end face that the end portions 22E of the main rebar 22 do not project out from) of the column member 20. As illustrated in Fig. 1B, the respective tubular sheaths 30 are arranged running alongside the main rebar 22 embedded in the column member 20. The tubular sheaths 30 are disposed further toward the outer side of the column member 20 than the main rebar 22.

[0024] One end portion of each bar of the coupling main rebar 22A is inserted into the corresponding tubular sheath 30. In a state in which the one end portions of the coupling main rebar 22A have been inserted into the respective tubular sheaths 30, a grout material is poured between the coupling main rebar 22A and inner walls of the tubular sheaths 30. An overlapping coupling is thereby formed between the coupling main rebar 22A and the main rebar 22. The end portions 22E of the main rebar 22 are disposed on center lines of the respective tubular sheaths 30 and on extension lines of the respective coupling main rebar 22A. In other words, the coupling main rebar 22A and the end portions 22E of the main rebar 22 are substantially disposed along a single straight line.

[0025] Note that another end portion of each bar of the coupling main rebar 22A may be directly embedded in a separate precast concrete member, or may be inserted into a tubular sheath embedded in a separate precast concrete member. Alternatively, the other end portion of each bar of the coupling main rebar 22A may be embedded in cast-in-place concrete.

[0026] As illustrated in Fig. 1B, each of the reinforcing ties 40 is a discrete reinforcing tie formed in an annular shape (ring shape). Each of the reinforcing ties 40 encircles one of the tubular sheaths 30 and the corresponding main rebar 22, and is integrated with the tubular sheath 30. There are no particular limitations to the method of integrating the reinforcing tie 40 and the tubular sheath 30, and a desired method such as welding or adhesion may be employed therefor.

[0027] Each of the reinforcing ties 40 is disposed so as to leave a space between itself and the corresponding main rebar 22. Concrete to form the column member 20 is filled into the space between the reinforcing tie 40 and the main rebar 22. Note that as an example, this space is preferably formed with a minimum dimension of greater than 5 mm. The concrete is thus formed by filling the gap with at least cement and a fine aggregate with a diameter of no greater than 5 mm.

[0028] As illustrated in Fig. 1A, plural of the reinforcing ties 40 are arranged at a predetermined pitch P2 along the axial direction of the column member 20. The pitch P2 is the same as the pitch P1 of the hoop ties 24. Thus, the placement of the reinforcing ties 40 does not interfere with that of the hoop ties 24. Note that although the pitches P1, P2 are the same in terms of design dimensions, some difference therebetween due to manufacturing tolerance is acceptable.

[0029] Precast Concrete Member Join Structure

As illustrated in Fig. 2, a beam member 50 is joined to the column member 20 at the construction site. Specifically, the column members 20 and the beam member 50 are fixed together in a state in which the beam member 50 has been sandwiched between two column members 20 disposed above and below the beam member 50. Note that for ease of explanation in the present specification, the lower column member 20 is referred to as the column member 20D, and the upper column member 20 is referred to as the column member 20U as appropriate.

[0030] The beam member 50 is a precast concrete member in which a joint portion 52 for joining a beam body to the column member 20, and beam end portions 54, form an integral unit. The non-illustrated beam body is joined to the beam end portions 54. The joint portion 52 has substantially the same shape as the column member 20 in plan view. Tubular sheaths 56 are embedded in the joint portion 52.

[0031] In plan view of a state in which the joint portion 52 and the column members 20 are superimposed on each other, the positions of the tubular sheaths 56 are aligned with the tubular sheaths 30 of the column members 20. Upper and lower end portions of the tubular sheaths 56 open onto respective upper and lower end faces of the joint portion 52. Namely, the tubular sheaths 56 are arranged penetrating the joint portion 52.

[0032] The column member 20D, the beam member 50, and the column member 20U are stacked on each other in this sequence from the lower side. In this state, the tubular sheaths 56 of the beam member 50 and the tubular sheaths 30 of the column member 20U form insertion holes that are in communication with each other. The main rebar 22 of the column member 20D is inserted through these communication holes. These communication holes are then filled with grout.

[0033] Precast Concrete Member Joining Method

In order to join the column member 20D, the beam member 50, and the column member 20U together, first, as illustrated in Fig. 3A, the column member 20D is installed at a specific position. The coupling main rebar 22A projecting out at the installation location are inserted into the tubular sheaths 30 opening onto a lower end face of the column member 20D. Grout is then poured into the tubular sheaths 30 to fix the column member 20D at the installation location. Note that this installation location may be any desired location, such as a grade beam, a slab, or a column. Such a grade beam, slab, or column may be made of cast-in-place concrete, or of precast concrete.

[0034] Next, the beam member 50 is placed on top of the column member 20D. Namely, the beam member 50 is hoisted and lowered using a crane, such that the main rebar 22 projecting out from an upper end face of the column member 20D are inserted through the tubular sheaths 56 of the joint portion 52. Note that a spacer or the like is used to provide a vertical direction space (not illustrated in the drawings) between the column member 20D and the beam member 50.

[0035] After the beam member 50 has been placed on top of the column member 20D as illustrated in Fig. 3B, grout is poured into the tubular sheaths 56 of the beam member 50. The grout is also filled into the space between the column member 20D and the beam member 50 when this is performed. The column member 20D and the beam member 50 are fixed together in this manner.

[0036] Next, the column member 20U is placed on top of the beam member 50. Namely, the column member 20U is hoisted and then lowered using a crane, similarly to the beam member 50. When this is performed, the main rebar 22 of the column member 20D projecting out from an upper end face of the beam member 50 are inserted into the tubular

sheaths 30 of the column member 20U. Note that a spacer or the like is used to provide a space between the beam member 50 and the column member 20U.

[0037] After the column member 20U has been placed on top of the beam member 50 as illustrated in Fig. 2, grout is poured into the tubular sheaths 30 of the column member 20U. The grout is also filled into the space between the column member 20U and the beam member 50 when this is performed. The column member 20U and the beam member 50 are fixed together in this manner.

[0038] Operation and Advantageous Effects

As illustrated in Fig. 1A, in the column member 20 according to the present exemplary embodiment, the tubular sheaths 30 are embedded so as to run alongside the main rebar 22 embedded in the precast concrete. An overlapping coupling between the coupling main rebar 22A and the main rebar 22 is configured by inserting and fixing the coupling main rebar 22A in the tubular sheaths 30.

[0039] The strength of the overlapping coupling may be determined by the cohesion strength between outer peripheral faces of the tubular sheaths 30 and the concrete. In the present embodiment, the reinforcing ties 40 that encircle the tubular sheaths 30 and the main rebar 22 are integrated with the respective tubular sheaths 30. This enables the cohesion strength to be improved, and the length of the overlapping coupling to be shortened. Moreover, the strength of the coupling can be secured.

[0040] This enables rebar coupling strength to be secured without for example employing a mechanical coupling such as a cast iron coupler.

[0041] Moreover, in the column member 20 according to the present exemplary embodiment, the hoop ties 24 are arranged between the reinforcing ties 40. Thus, the hoop ties 24 and the reinforcing ties 40 do not impinge on one another. The reinforcing ties 40 are therefore less liable to get in the way during an operation to provide the hoop ties 24.

[0042] Moreover, in the column member 20 according to the present exemplary embodiment, as illustrated in Fig. 4, the tubular sheaths 30 are formed with flat and smooth outer peripheral faces. This enables the corresponding reinforcing ties 40 to be fixed at any desired position. In contrast thereto, in for example cases in which protrusions are formed on the outer peripheral face of the tubular sheath 30, it would be difficult to lay the reinforcing ties 40 at these protrusions out of consideration for the thickness of the covering concrete.

[0043] No such protrusions are formed to the tubular sheaths 30 according to the present exemplary embodiment. This enables the pitch of the reinforcing ties 40 to be adjusted to any desired value according to the pitch of the hoop ties 24. Note that "flat and smooth" and "no such protrusions are formed" do not refer only to a state in which no unevenness is

present whatsoever. Exemplary embodiments of the present disclosure also encompass states in which unevenness such as embossing or burring formed during manufacturing processes is present to an extent that does not affect placement of the reinforcing ties 40.

[0044] Other Exemplary Embodiments

Although the pitch P2 of the reinforcing ties 40 is uniform in the present exemplary embodiment as illustrated in Fig. 1A, exemplary embodiments of the present disclosure are not limited thereto.

[0045] For example, as illustrated in Fig. 5, the pitch of the reinforcing ties 40 may be varied along the axial direction of the column member 20. In Fig. 5, a pitch P3 of the reinforcing ties 40 in the vicinity of the end portions 22F of the main rebar 22 and end portions 22AF of the coupling main rebar 22A is smaller than a pitch P4 of the reinforcing ties 40 at other locations. This enables the cohesive force with the concrete to be increased near to the end portions 22F, 22AF that are subject to greater internal stresses.

[0046] Moreover, the outer peripheral faces of tubular sheaths of the present disclosure do not have to be formed smooth and flat. As in the example of tubular sheaths 32 illustrated in Fig. 6, the outer peripheral faces may be formed with a concertina profile. The outer peripheral face of each of the tubular sheaths 32 is alternately formed with concave portions (grooves) 32A and convex portions (peaks) 32B along the axial direction of the column member 20.

[0047] Forming the tubular sheaths in this manner enables the reinforcing ties 40 to be engaged with the concave portions 32A. This facilitates the transmission of stress between the tubular sheaths 32 and the reinforcing ties 40. Moreover, the reinforcing ties 40 can be integrated with the tubular sheaths 32 without physically joining the tubular sheaths 32 and the reinforcing ties 40 together, or by employing only a simple physical join. Furthermore, the hoop ties 24 can also be engaged with the concave portions 32A. This facilitates the provision of the hoop ties 24. Furthermore, the cohesive force between the tubular sheaths and the concrete can also be increased.

[0048] Note that in the present disclosure, regarding "the reinforcing ties being integrated with the tubular sheaths", it is sufficient that stress can be transmitted between the reinforcing ties and the tubular sheaths inside the precast concrete member, as in case of the reinforcing ties 40 that are engaged with the concave portions 32A of the tubular sheaths 32. Namely, the tubular sheaths and the reinforcing ties do not necessarily have to be physically joined together by means such as welding or adhesion.

[0049] Moreover, although each of the reinforcing ties 40 is formed in an annular shape in the present exemplary embodiment, exemplary embodiments of the present disclosure are not

limited thereto. For example, reinforcing ties 42 may be formed in a helical shape as illustrated in Fig. 7. Forming the reinforcing ties in this manner enables the number of components to be reduced compared to cases in which reinforcing ties are formed in annular shapes.

[0050] Moreover, although a method (what is referred to as an in-sequence spearing process) has been explained in the present exemplary embodiment in which the main rebar 22 projecting from the upper end portion of the column member 20D is inserted into the tubular sheaths 30 opening onto a lower end portion of the column member 20U as illustrated in Fig. 3B, exemplary embodiments of the present disclosure are not limited thereto.

[0051] For example, as illustrated in Fig. 8, a method (what is referred to as a reverse spearing process) may be adopted in which main rebar 22 projecting from the lower end portion of the column member 20U is inserted into tubular sheaths 30 opening onto the upper end portion of the column member 20D. Namely, the placement direction of the column members 20 may be arranged as desired.

[0052] Although an example has been described in the present exemplary embodiment in which the column members 20U, 20D, serving as precast concrete members, and the beam member 50 are joined together, exemplary embodiments of the present disclosure are not limited thereto. For example, the column members 20U, 20D may be joined together without interposing the beam member 50 therebetween.

[0053] Furthermore, instead of column members, beam members may be employed as the precast concrete members. For example, beam members with a similar configuration to the column member 20 may be arranged along a horizontal direction and joined together. Thus, the present disclosure may be implemented in various manners.

[0054] The entire content of the disclosure of Japanese Patent Application No. 2019-231551 filed on December 23, 2019 is incorporated by reference in the present specification. All cited documents, patent applications, and technical standards mentioned in the present specification are incorporated by reference in the present specification to the same extent as if each individual cited document, patent application, or technical standard was specifically and individually indicated to be incorporated by reference.

CLAIMS

1. A precast concrete member, comprising:
 - a main rebar that is embedded in precast concrete;
 - a tubular sheath that is embedded in the precast concrete alongside the main rebar and into which a coupling main rebar is inserted and fixed; and
 - a reinforcing tie that encircles the tubular sheath and the main rebar and that is assembled with the tubular sheath.
2. The precast concrete member of claim 1, wherein a groove with which the reinforcing tie, which is ring-shaped, engages is formed at an outer peripheral face of the tubular sheath.
3. The precast concrete member of claim 1 or claim 2, wherein the precast concrete is a columnar member and hoop ties are arranged between the reinforcing ties.