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(54) **SLIP FORMED CONCRETE STRUCTURE**

GLEITSCHALUNGSGEFORMTE BETONSTRUKTUR

STRUCTURE EN BÉTON FORMÉE PAR COFFRAGE GLISSANT

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EP 2 622 151 B1

Description

Field of the invention

[0001] The present invention relates to a method of building a concrete structure according to the preamble of claim 1.

Background of the invention and prior art

[0002] Currently, many concrete structures, such as concrete shafts, are typically formed by slip forming, alternatively termed slip casting. Compared to forming with fixed forms, slip forming is very favorable, particularly from an economical point of view, since the extent of the work is greatly reduced. However, the surface of a slip formed concrete structure includes irregularities, particularly when high strength, abrasion resistant concrete qualities are used. The result is reduced erosion and abrasion resistance, reduced service life and reduced surface quality, compared to a structure having a smooth surface, all of which has technical and economical consequences. Repair of irregularities or eroded or abraded surface is often very expensive and the quality is still reduced. Forming with fixed forms for all or a part of a concrete structure is often very expensive.

[0003] JPS5365636 U discloses a method according to the preamble of claim 1.

[0004] Structures used in the sea in areas infested by drifting surface ice have so far not been protected in the zone abraded by ice by a slip formed concrete abrasion allowance, but with a protective steel structure, due to the above mentioned technical problems. For concrete structures such steel protection is very expensive, requiring extensive scaffolding and additional work at high elevation, and may not be a good technical solution since the integrity has been questionable. Protection using concrete has so far not been possible for the desired reliable, long-lasting, affordable and simple solutions sought for by the industry.

[0005] The objective of the invention is to provide a method of building a concrete structure, providing improvements with respect to the above mentioned problems and disadvantages.

Summary of the invention

[0006] The invention provides a method of building a concrete structure, according to claim 1.

[0007] Preferably, the abrasion allowance is formed by concrete, without steel armour reinforcement except of possible fibres that optionally may be steel fibres.

[0008] The concrete structure is for use offshore in ice-infested areas, the structure has an increased thickness as an abrasion allowance in a zone abraded by ice drifting on the sea, and the abrasion allowance has been formed by slip forming with panels inside the slip form, the panels facing the slip form.

[0009] The method of the invention surprisingly results in a slip formed concrete structure or -part having smooth, plane and hard surface without irregularities such as small cracks, crazes or voids, which has been impossible so far in full scale production, particularly when using hard high strength, abrasion resistant air-rich concrete qualities . Without wishing to be bound by theory, it is assumed that the present invention eliminates or reduces irregularities, particularly lifting crazes or -cracks, in the surface of the ice abrasion allowance as the slip form is lifted upwards, and that such irregularities previously have been the main reason for reduced service life and high abrasion rate. The technical effect can be beneficial for any concrete structure, particularly for high strength quality concrete structures exposed for erosion or abrasion or wear for any reason, for any structures for which reduced drag or friction can be beneficial, and structures for which subsequent treatment can be facilitated. Deterioration, wear, ageing, ingress of salts and chemicals all take place in principle from the surface and inwards, for which reason the method according to the invention can be advantageous since better resistance is provided. Testing so far has confirmed the beneficial technical effect; however, it may take many years of service and testing in order to quantify the technical effect in all of the different aspects thereof.

[0010] The term panel means in this context any in substance two dimensional structure useful for the intended purpose. Examples are plates of any feasible material such as metal, polymer material, composite material, concrete and ceramic material. Panels also include any grid, grating, mesh or honeycomb-like plate-like structures. The panels are preferably having a shape adapted for the site it is used, such as the curvature of a platform shaft with round cross section shape. The panels are arranged on the outer side of the abrasion allowance, facing the slip form.

[0011] The panels are removed from the structure after the slip forming. A smooth inner surface is preferred for panels that are removed.

[0012] The abrasion allowance is formed by concrete, preferably without steel armour reinforcement except of possible reinforcing fibres that optionally may be steel fibres. Any steel reinforcement armouring of the abrasion allowance is preferably without electrical or mechanical contact with the main steel reinforcement armouring.

[0013] The length of increased thickness, that is the elevation range of the ice abrasion allowance, preferably encompass the range abraded by drifting ice, which is from the lowest ice draught level at lowest water tide level to the highest expected ice top at the highest water tide level for a gravity base structure. For a floating concrete structure, the tidal range is replaced by the ballast range for the specification of required elevation range having abrasion allowance.

[0014] The transition from the ordinary structure to the structure of increased thickness is gradual and formed by an insert form onto which the panels are arranged.

Preferably both the panels and the insert form have means for being arranged or connected together, such as by a wedge system, bolts or male-female means.

Figures

[0015] The invention is illustrated with figures, of which:

Figures 1 to 5 illustrate sections through a structure according to the invention having an abrasion allowance.

Detailed description

[0016] Reference is made to Fig. 1, illustrating a section through a wall of a gravity base shaft structure 1 that is slip formed and which shall be provided with an abrasion allowance according to the invention. A slip form yoke 2 and working platforms 3 are lifted upwards concurrently as the structure is slip formed upwards, in a conventional way.

[0017] In Figure 2, a bolted support 4 and an insert form 5 have been arranged on the outer wall of the structure. In Figure 3 the first panel 6 has been arranged on the insert form 5. The volume inside the panel is filled with concrete of a feasible quality for abrasion resistance and behaviour in the forming operation, which quality may be determined by testing. The armouring is not illustrated. Preferably the steel armouring is not extended into the abrasion allowance, but the abrasion allowance may preferably comprise reinforcing fibres such as steel fibres, carbon fibres, boron fibres or other fibres or ceramics or other material for increased abrasion resistance and/or strength. The main structure armouring will thereby not be exposed as the erosion allowance is eroded.

[0018] Figures 4 and 5 illustrate how the structure is slip casted further, arranging panels successively upwards in order to cover the structure with abrasion allowance over the intended distance or elevation range. The figures also illustrate how the abrasion allowance is terminated at the upper end in a corresponding way as it was started in the lower end, i.e with an insert form and a bolted support. The supports, insert forms and panels are preferably provided with means for being connected together, preferably in a releasable way. During slip forming the slip form slip or slide on the panels, not on the concrete of the abrasion allowance. Accordingly, the concrete of the abrasion allowance is not subjected to shear forces by the slip form.

[0019] Preferably the panels, any insert forms and any bolted supports are all removed after the forming operation, leaving a smooth, plane, hard and abrasion resistant regular surface of the abrasion allowance on the structure. Extensive testing has revealed that a concrete quality such as B70 (CEN: C70/85, ref. ISO 19906) is feasible for abrasion allowance. Testing and modelling has revealed that an abrasion allowance thickness of 105-122 mm, over an elevation range of typical 6,6 m encompassing the ice drift abraded zone, for a service life of 40 years on shafts of a gravity base structure in ice infested areas, is convenient.

[0020] Testing has revealed that the contents of small cracks or crevices on a concrete surface is dramatically reduced, and the surface become far smoother, with far less irregularities, by slip forming with panels with smooth panel inner surface and removing said panels after forming, according to the invention. The result is inter alia an improved ice abrasion resistance, a reduction in ice formation on the structure per se, increased resistance to repeated cycles of freezing and melting, reduced friction and prolonged service life of the structure.

Claims

1. Method of building a concrete structure (1), whereby at least a part of said concrete structure (1) 5 is formed by slip forming with panels (6) inside the slip form, said panels (6) facing the slip form, wherein said panels (6) are removed from said concrete structure (1) after the slip forming, the method is for building said concrete structure (1) for use offshore in ice-infested areas,
wherein said concrete structure (1) has an increased thickness as an abrasion allowance in a zone abraded by ice drifting on the sea, **characterised in that** the transition from the ordinary structure to the structure of increased thickness is gradual and formed by an insert form (5) onto which said panels (6) are arranged.

2. Method according to claim 1, **characterised in that** the abrasion allowance is formed by concrete, without steel armour reinforcement except of possible fibres that optionally may be steel fibres.

Patentansprüche

1. Verfahren zum Bauen einer Betonstruktur (1), wobei zumindest ein Teil der Betonstruktur (1) durch Gleitschalungsfertigung mit Schalungen (6) innerhalb der Gleitschalungsform gebildet wird, wobei die Schalungen (6) der Gleitschalungsform gegenüberliegen, wobei die Schaltungen (6) von der Betonstruktur (1) nach der Gleitschalungsfertigung entfernt werden, wobei das Verfahren zum Bauen der Betonstruktur (1) zur Offshore-Verwendung in vereisten Gebieten bestimmt ist, wobei die Betonstruktur (1) eine größere Dicke als die Abriebstoleranz in einer abgeriebenen Zone durch Eisbewegungen auf der See aufweist, **dadurch gekennzeichnet, dass** der Übergang von der gewöhnlichen Struktur zur Struktur mit erhöhter Dicke kontinuierlich und durch einen Formeinsatz (5), auf welchem die Schalungen (6) ange-

ordnet sind, gebildet wird.

2. Verfahren nach Anspruch 1, **dadurch gekennzeichnet, dass** die Ab-riebstoleranz durch Beton gebildet ist, ohne Stahlarmierungsverstärkung, mit Ausnahme von möglichen Fasern, welche optional Stahlfasern sein können.

Revendications

1. Procédé de fabrication d'une structure en béton (1) dans lequel au moins une partie de ladite structure en béton (1) est formée par coffrage glissant avec des panneaux (6) à l'intérieur du coffrage glissant, lesdits panneaux (6) faisant face au coffrage glissant, dans lequel lesdits panneaux (6) sont enlevés de ladite structure en béton (1) après le moulage en coffrage glissant, le procédé étant conçu pour fabriquer ladite structure en béton (1) à utiliser en mer dans une région à forte concentration de glace, dans lequel ladite structure en béton (1) présente une épaisseur accrue et une tolérance à l'abrasion dans une zone abrasée par de la glace dérivant en mer, **caractérisé en ce que** la transition entre la structure ordinaire et la structure d'épaisseur accrue est progressive et formée par un élément d'insert (5) sur lequel lesdits panneaux (6) sont agencés.

2. Procédé selon la revendication 1, **caractérisé en ce que** la tolérance d'abrasion est formée par du béton, sans renforcement de blindage d'acier à l'exception d'éventuelles fibres qui peuvent facultativement être des fibres d'acier.

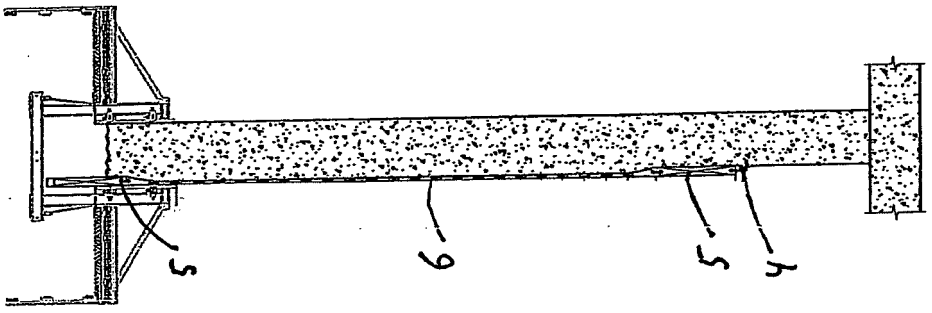

Fig. 5

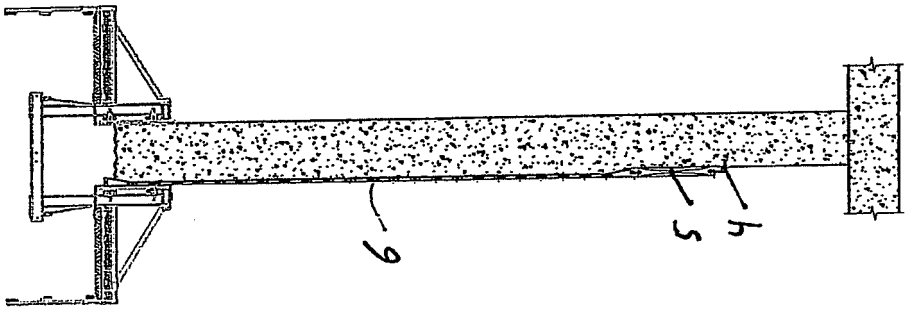

Fig. 4

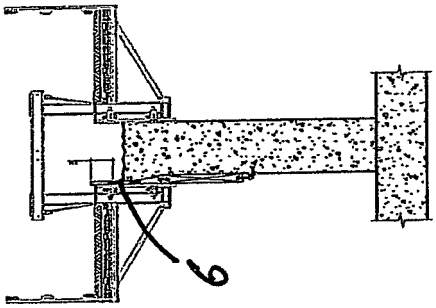

Fig. 3

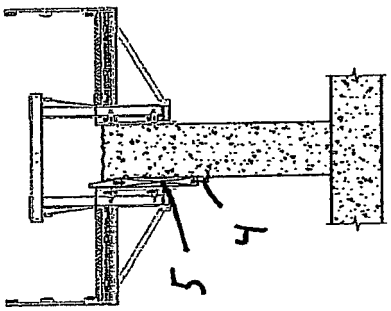

Fig. 2

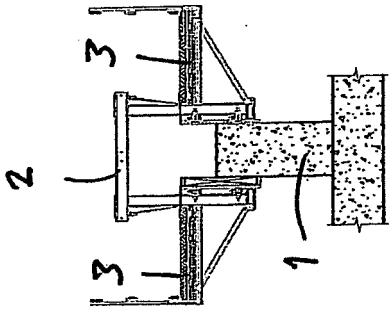

Fig. 1