

SEGMENT MANUFACTURING METHOD USING
HIGH FLUIDITY CONCRETE AND COVERED FORMWORK

BACKGROUND OF THE INVENTION:

Field of the Invention:

The present invention relates to a concrete segment manufacturing method.

Description of the Prior Art:

In the manufacture of a concrete segment in the prior art, a super hard mixed concrete of a slump of approximately 3 cm is used. Thus, due to insufficiency in a deformation performance of the concrete, in order to fill the concrete densely in a formwork at the time of concrete placing, there becomes necessary a strong vibration squeezing.

Also, as a covered formwork cannot be used, a trowel finishing becomes necessary for a surface finishing and a work for the finishing is done manually.

According to the manufacturing method of a concrete segment in the prior art, as a super hard mixed concrete is used as mentioned above, there is an insufficiency in a deformation performance of the concrete so that the concrete is hardly filled in the formwork and a strong vibration squeezing for filling of the concrete is necessary, thus there arises an undesirable influence on

the neighboring environment due to vibration noises, and in order to maintain a dimensional accuracy even in the strong vibration, a formwork having a high rigidity and a large weight for a high accuracy work becomes necessary. Further, a surface finishing such as by a trowel finishing etc. becomes necessary, which requires a lot of manual work, and a labor saving is not attained yet.

SUMMARY OF THE INVENTION:

In view of said problems in the prior art, it is an object of the present invention to provide a segment manufacturing method using a high fluidity concrete and a covered formwork in which no bubble crater occurs in a finished product, a trowel finishing becomes unnecessary, a labor saving is attained in a surface finishing work and a vibration squeezing at the time of concrete placing becomes unnecessary, thereby no undesirable influence arises on the neighboring environment and a simplification of the formwork can be attained.

In order to attain said object, the present invention discloses a segment manufacturing method using a high fluidity concrete and a covered formwork, wherein said high fluidity concrete is poured in a closed formwork comprising a formwork cover consisting of a perforated steel plate having air holes and a permeable finishing element

disposed on an underside of said perforated steel plate, thereby a finished surface is formed so that a vibration squeezing and a surface finishing become unnecessary.

According to the present invention of Claim 2, it is a feature that said concrete is mixed in a water cement ratio of 30 to 40% and a fine aggregate rate of 45 to 55% and with a small amount of admixture so that a slump flow value is 65 ± 5 cm, a V funnel flow-down time is 25 ± 15 seconds and an air amount is $2 \pm 1\%$.

According to the present invention of Claim 3, a time while a fresh nature of the concrete is held is approximately 30 minutes or more.

BRIEF DESCRIPTION OF THE DRAWINGS:

In the accompanying drawings:

Fig. 1 is a perspective view showing a state of manufacturing a segment by a method of the present invention.

Fig. 2 is a perspective view showing a formwork cover used in the present invention.

Fig. 3 is a perspective view showing a formwork cover made of a non-perforated steel plate.

DESCRIPTION OF THE PREFERRED EMBODIMENTS:

Herebelow, description is made on preferred

embodiments according to the present invention with reference to Figs. 1 to 3. Numeral 1 designates a steel-made formwork, disposed horizontally likewise the prior art, for manufacturing a segment, numeral 2 designates a formwork cover, numerals 3 and 4 designate a funnel-like concrete pouring portion provided on said formwork cover 2 and a concrete hopper for supplying a concrete into said funnel-like concrete pouring portion, respectively.

It is found that, in case of a formwork cover 2' which uses only a non-perforated steel plate as a formwork cover, a high fluidity concrete 5 is poured and a filling ability around an edge and a joint can be ensured but, there arising numerous bubble craters each of about 10 mm depth on a finished surface, a cover of a concrete segment reinforcement set within said steel-made formwork for manufacturing a segment becomes insufficient.

From the above, it is known that there is a necessity of air holes for eliminating the bubble craters and use of a perforated steel plate formwork cover will be effective. As for holes 2a of the formwork cover 2 made of a perforated steel plate, an optimum dimensional selection being made in view of an eliminating effect of the bubble craters on the finished surface and an amount of a cement paste leaking from the holes 2a, a punched plate is set as a standard with dimensions that a hole diameter effective

for eliminating the bubble craters is 3 mm and a hole-to-hole pitch is 5 mm.

In case a concrete segment is manufactured, a high fluidity concrete 5 is poured from the concrete hopper 4 via the funnel-like concrete pouring portion 3 to be filled in the steel-made formwork 1 for manufacturing a segment, so that a concrete segment is molded and bubble craters on a surface of such molded item are prevented from occurring by use of said holes 2a of the formwork cover 2.

At this time, there occur cloggings of the holes 2a of the perforated steel plate composing the formwork cover 2 by the cement paste leaking from the holes 2a, and time and labor are required for cleaning of the formwork 2. So, in order to alleviate such time and labor for cleaning of the formwork 2, a permeable finishing element 6 is provided on an underside of the perforated steel plate composing the formwork cover 2.

Such permeable finishing element 6 can be selected from a mesh wire having a mesh size of 0.25 mm or a fibrous material, such as a permeable sheet, non-woven fabric, woven fabric, etc., having good results in a bubble eliminating effect on a surface of a placed concrete, and the formwork 2 can be selected in various combinations of the perforated steel plate and the finishing element from a need of easiness in cleaning of the perforated steel plate, easiness

in applying to the perforated steel plate, cost, etc.

Mixing of the high fluidity concrete 5 to be supplied into the steel-made formwork 1 for manufacturing a segment is as follows:

(Example of mixing)

Mixing kg/m ²	W	C	S	G	Admixture
	187	592	846	821	10.656

Where, water cement ratio $W/C = 30$ to 40%

fine aggregate rate $b/a = 45$ to 55%

The admixture is a complex of a polycarboxylic-acidether race and a cross-linked polymer, such as mentioned herebelow, mixed in a range of $C \times 2.9\%$ to $C \times 1.5\%$;

- (1) Tradename: RHEOBUILD SP-8S (Pozzolith Bussan, Ltd.)
- (2) Tradename: PARIC FP-300 U Series (FPK K.K.)
- (3) Tradename: CHUPOL HP-11 Series (Takemoto Oil & Fat Co., Ltd.)

As the above-mentioned high fluidity concrete is of a low water cement ratio, a long term strength which is required for a segment can be satisfied enough.

Also, as an ordinary cement is used, an initial strength can well satisfy a mold separation strength of the segment.

Further, as the water cement ratio is low, an excellent endurance ability, such as a resistible nature against neutralization, etc. can be obtained.

From the above, it is proved that the example of mixing of the high fluidity concrete 5 according to this preferred embodiment is excellent.

Also, in case a slump flow value of this concrete 5 is 65 ± 5 cm, an excellent workability is obtained and, a filling performance verification test being taken place by use of a quarter model of segment, an excellent filling performance is obtained.

It is also found that, if the slump flow value is 50 to 60 cm which is lower than that of the present preferred embodiment, there remain many non-filled portions and if the slump flow value is beyond 70 cm which is higher than that of the present preferred embodiment, there occurs a lot of material separation.

Also, proved is that if a V funnel flow-down time of the concrete is 25 ± 15 seconds, no material separation is found in the test results and a quality control value of the high fluidity concrete of the present preferred embodiment is excellent.

Incidentally, an air amount is $2 \pm 1\%$ which is same as that in a concrete for a segment in the prior art. Also, in case a formwork cover 2' which uses only a non-

perforated steel plate as shown in Fig. 3 is used as the formwork cover, a high fluidity concrete 5 is poured and a filling ability around an edge and a joint can be secured, but there arise numerous bubble craters each of about 10 mm depth on a finished surface and a cover of a concrete segment reinforcement set within said steel-made formwork for manufacturing a segment becomes insufficient.

Therefore, air holes become necessary for eliminating the bubble craters and a perforated steel plate formwork cover is used, thereby the bubble craters are eliminated.

Incidentally, as to the concrete used for manufacturing said segment, the holding time while its fresh nature is held is made approximately 30 minutes or more, thereby the workability and the quality can be enhanced with a favorable effect on the economy also.

Said holding time can be made either 60 minutes or 90 minutes but there is no necessity of such a long holding time for manufacture of the segment. In order to make the holding time longer, the amount of admixture must be increased and then a growth of concrete strength is belated thereby. In such a concrete secondary product as a segment, a high initial strength is required.

If the holding time is too short (five minutes, for example) reversely, there occurs an obstacle in the

manufacturing work of the segments.

According to the method of the present invention, a concrete having a high fluidity is used, thereby a deformation performance of the concrete increases, filling into the formwork becomes easy and yet the filling can be done naturally by gravity even if no squeezing is performed. Thus, no squeezing being required, the formwork can be simplified and an undesirable influence on the neighboring environment, such as noises, vibrations, etc. can be reduced.

Also, according to the present invention, by use of a closed formwork comprizing a formwork cover provided with a permeable finishing element on an underside of a perforated steel plate, a finished surface is formed without bubble crators occurring thereon, thus a trowel finishing becomes unnecessary, such a surface finishing as so far been made manually is eliminated and cloggings of the air holes of the formwork cover, when occurred, by leakage of the cement paste can be cleaned easily.

Thus, according to the present invention, labor saving in the surface finishing work, elimination of the vibration squeezing at the time of concrete placing, stationary setting of the formwork and simplification of the formwork are attained and the cost of segment products can be reduced.

According to the invention of Claim 2, said concrete is an ordinary cement and is mixed in a water cement ratio of 30 to 40% and a fine aggregate rate of 45 to 55% and with a small amount of admixture, thereby a long term strength required for a segment can be satisfied, a mold separation strength of cement can be well satisfied by the initial strength and an excellent endurance ability, such as a resistible nature against neutralization, etc. can be obtained.

Further, an admixture is added so as to make the slump flow value of 65 ± 5 cm, thereby a filling ability can be ensured. And a V funnel flow-down time of 25 ± 15 seconds is attained, thereby a material separation in the concrete is avoided and an excellent quality can be obtained.

According to the invention of Claim 3, a time while the fresh nature of the concrete is held is set to approximately 30 minutes or more, thereby a workability can be enhanced.

While the preferred form of the present invention has been described, variation thereto will occur to those skilled in the art within the scope of the present inventive concepts which are delineated by the following claims.

WHAT IS CLAIMED IS:

1. A segment manufacturing method using a high fluidity concrete and a covered formwork, wherein said high fluidity concrete is poured in a closed formwork comprising a formwork cover consisting of a perforated steel plate having air holes and a permeable finishing element disposed on an underside of said perforated steel plate, thereby a finished surface is formed so that a vibration squeezing and a surface finishing become unnecessary.

2. A segment manufacturing method as claimed in Claim 1, wherein said concrete is mixed in a water cement ratio of 30 to 40% and a fine aggregate rate of 45 to 55% and with a small amount of admixture so that a slump flow value is 65 ± 5 cm, a V funnel flow-down time is 25 ± 15 seconds and an air amount is $2 \pm 1\%$.

3. A segment manufacturing method as claimed in Claim 1, wherein a time while a fresh nature of said concrete is held is approximately 30 minutes or more.

