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Autor: Miyazaki, Shoji / Iki, Shohei / Noda, Yukie

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KAWADA INDUSTRIES, INC.

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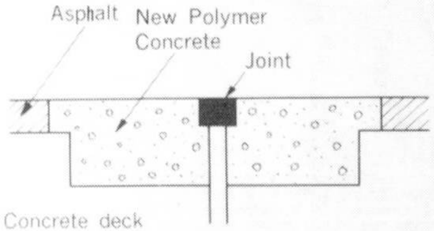
NEW APPLICATION OF POLYMER CONCRETE IN REHABILITATION OF EXPANSION JOINT



1. BACKGROUND

The main cause of damage of end dam concrete is considered as large repeated impact of vehicles due to the different lebel between the end dam concrete and expansion steel or asphalt.

Therefore, We consider that excellent impact resistance and abrasion resistance of end dam concrete must be the most important characteristics and developed resin concrete, which is mixture of convensional epoxy resin and synthetic rubber.

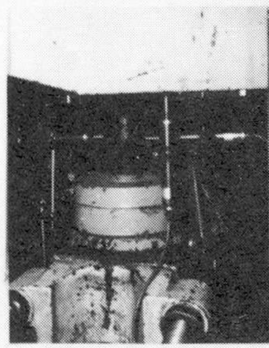
2. FEATURES OF NEW CONCRETE

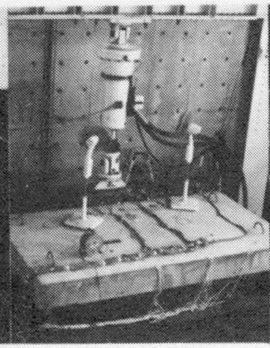
This concrete has a low coefficient of elastisity ($E = 2 \sim 8 \times 10^4$ kg cm^2) and is applicable to low temperature.

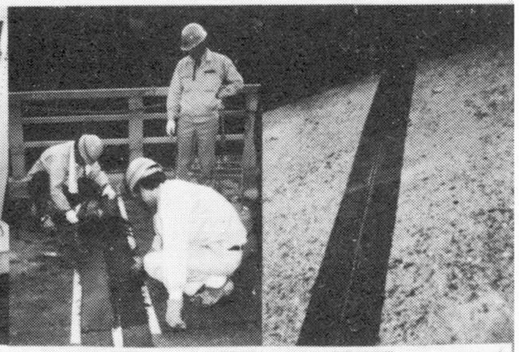
The component materials are as follows ;

Binder : mixture of epoxy resin and chloroprene rubber.

Aggregate : dry sand and crushed stone.







3. EFFECT OF RUBBER

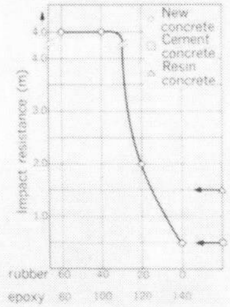


FIG.1 IMPACT RESISTANCE AND RUBBER WEIGHT

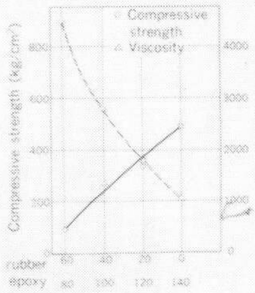
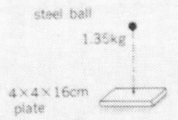


FIG.2 COMPRESSIVE STRENGH AND RUBBER WEIGHT



Impact strength test

The mixture ratio of the epoxy resin and the rubber gives an influence on the dynamic characteristics, the time of hardening and the workability.

4. FLOW AND ABRASION RESISTANCE

Type	New concrete	Resin concrete	Cement concrete
New material binder	1		(kg)
Resin concrete binder		1	
cement			400
Fine aggregate	3	3	650
Coarse aggregate	5	5	1,240
Water			150
Flow resistance	0.01mm	0.01mm	
Abrasion resistance(cm^3)	0.04	0.34	1.65

Flow resistance : Wheel tracking test

Tire contact pressure	6.4kg/cm^2
Temperature	60°C
Testing time	60min.

Abrasion resistance : Ravelling test

Chain	7mm dia. cross-chain
Temperature	−10°C
Testing time	90min.

New Application of Polymer Concrete in Rehabilitation of Expansion Joints

Shoji MIYAZAKI
Kawada Industries, Inc.
Tokyo, Japan

Shohei IKI
Kawada Industries, Inc.
Tokyo, Japan

Yukie NODA
Kawada Industries, Inc.
Tokyo, Japan

1. PREFACE

In order to reopen the road to traffic immediately or in at least a few hours after repair of an expansion joint, high-early-strength concrete or resin concrete are widely used on the end dam to fill the gap between the new expansion joint and concrete slab or pavement. But the difference in coefficient of thermal expansion between normal and resin concrete lead to early cracks and finally to destruction of the resin concrete dam and further more, the end dam concrete must take a repeated impact force from the traffic.
To cope with this phenomenon, resin concrete should be given a cohesive and elastic characteristic to be able to dissipate the stress caused by the difference in coefficients of thermal expansion. This characteristic will prevent the cracking as well as improve the resistance to impact and abrasion of the resin concrete.
To fulfill these requirements a new resin concrete (elastomeric concrete) has been developped by adding synthetic rubber to ordinary epoxy resin concrete. This material has a relatively low coefficient of elasticity compared to conventional resin concrete.

2. MATERIALS USED

The components of elastomeric concrete are as follows.
- Binder: Mixture of epoxy resin and liquid chloroprene rubber.
- Fine Aggregate: Dry sand (No.7 + No.4).
- Coarse Aggregate: Dry crushed rock

3. CHARACTERISTICS OF ELASTOMERIC CONCRETE

The ratio of mixing the epoxy resin with rubber is an important factor which will influence not only the dynamic characteristics, but the required time for hardening and its workability.
The hardening time normally depends upon the atomospheric temperature during placement and curing of the concrete and it is possible to reduce the time for the concrete to harden with a high curing temperature.

(1) THE EFFECT OF RUBBER

From test results, it can be recognized that the impact resistivity increases in proportion with the increase of the rubber component and an extremely big change can be observed between the ratio of rubber and epoxy (rubber/ epoxy) of 0.4 and 0.25.
The compressive strength decreases in proportion with to the rubber content, but the viscosity of the binder becomes higher as the weight of rubber increase, therefore the workability goes down.
In addition to the strength, the resin to rubber ratio of 0.4 provides a low viscosity as well as a favorable workability.

(2) RESISTANCE TO ABRASION AND FLOW

A wheel tracking test and a ravelling test were performed under conventional methods (see poster).
Table-1 illustrates the results of the comparison test among the ultra-high-early-strength cement concrete, normal resin concrete and elastomeric concrete.
In the flow resistance test, there was no flow and showed no difference due to the type of material.
However, in respect to abrasion resistivity, the elastomeric concrete showed excellent characteristics.
These results show that the effects of rubber in the elastomeric concrete are recognizable.

(3) VISCOSITY AND WORKABILITY

The workability is affected by the viscosity of the binder and this viscosity is highly affected by the temperature.
When the viscosity of elastomeric concrete becomes lower than 2000 cps, the slump will be 5 to 6 cm. Therefore, good workability can be obtained.
Fig. 1 shows the relationship between the viscosity of binder and temperature.
The results indicate that a minimum temperature of 15°C is necessary in order to maintain favorable workability.
As a result, it is recommended to heat the binder and the hardener at worksite in winter.

(4) INITIAL HEATING CONDITIONS AND STRENGTH

Fig. 2 indicates the curve showing the relationship of compressive strength with time.
In this test, the test piece of elastomeric concrete is cured for an hour under the condition of a constant hot curing temperature, then it is left to cool under atmospheric temperature.

The result of the experiment shows that when atmospheric temperature is below 10°C, it is not possible for the elastomeric concrete to harden in a short time.
During the hardening process, elastomeric concrete generates much heat. By this heat the hardening time can be considerably accelerated.
Therefore, it is necessary for the concrete temperature to reach the temperature of reaction as early as possible.
In winter a curing temperature of 50°C to 60°C is thought to be necessary.

4. SUMMARY

- When the components of rubber in the Binder increase, the impact resistance of the elastic concrete also increases but the workability and the hardening time will decrease.
- The inclusion of ruber in the Binder gives a considerable improvement in the abrasion resistance.
- It is necessary to maintain the temperature of the Binder in order to keep a favorable workability in winter.

Table-1

Type	New concrete	Resin concrete	Cement concrete
New material binder	1		(kg)
Resin concrete binder		1	
cement			400
Fine aggregate	3	3	650
Coarse aggregate	3	5	1.240
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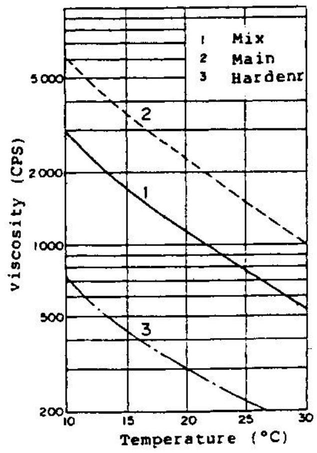

FIG. 1

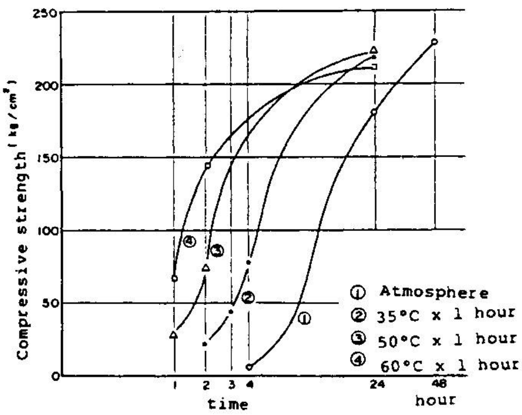

FIG. 2