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Försök med olika impregneringsmedel som skydd mot angrepp i virke av skeppsmask och borrkräfta

by

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DESCRIPTION OF A TRIAL WITH WOOD PRESERVATIVES AGAINST MARINE WOOD BORING ORGANISMS

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INTRODUCTION

Wood situated in sea water along the Atlantic coasts of the Nordic countries is attacked by marine wood boring organisms. Timber constructions in these waters therefore must be preservative treated.

In order to evaluate the effect of various preservatives against marine wood borers, the Nordic Wood Preservation Council (NWPC) organized a rather extensive trial in 1972. In the absence of and while awaiting international standard methods for testing preservatives it was felt that there was a need for a Nordic standard method. The 1972 trial was consequently planned and performed in close cooperation with the standardisation work. The complete standard method was published by NWPC in 1973 (NWPC Standard No. 1.4.2.2/73).

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SOME DATA REGARDING THE TEST STATION

The trial was located to Kristineberg Marine Biology Station in south west Sweden (fig. 1). This station was selected since marine wood borer work done there before had shown a frequent and rather stable population of wood borers. In Kristineberg, at the depth of interest for the test, there are two species of shipworms, *Teredo navalis*, L and *Psiloteredo megotara* H and one species of wood boring *Crustaceans*, *Limnoria lignorum* R (Nylinder-Norman et al. 1974). The period of settlement for the two Teredinidae is between June and September (Norman 1975).

Normally the salinity of the water varies between 20 and 33°/oo depending on the season and the prevailing steams (fig. 2). The surface water temperature is at its lowest from January to March (-1 to +3°C) and at its highest in July and August (+16 to +20°C). See fig. 2. The trial was started on 6th June 1972.

MATERIALS AND METHODS

Unplaned blocks, 2.5 x 7.5 x 20 cm in size, of Scots pine *(Pinus silvestris* L.), Europenan beech *(Fagus silvatica)* and European birch *(Betula verrucosa* Ehrh.) were used. A hole of 2.5 cm diameter was drilled in the center of the blocks (fig. 3).

The wood blocks were impregnated according to a full cell process as described in NWPC Standard 1.4.2.2/73. For the pine samples, 13 different preservatives were used. The principle types of these preservatives are listed in tab. 1. For the beech and birch samples, a copper-chrome-arsenic and a copper-polychlorophenol preservative were selected. Five different solution strengths of each preservative were used for the impregnation. The lowest solution strength corresponds to that normally recommended for wood in ground contact. Based on this lowest concentration (100 %), the following relative concentrations were tested: 100, 150, 200, 250 and 300 %.

The retentions were determined by weighing the samples immediately before and after the treatment. The retention in kg/m^3 sapwood was then calculated for each sample. In the tables the average retention of the six blocks in each series is reported.

Untreated blocks of pine (18), beech (6) and birch (6) were also included in the trial. These samples give an indication of the service life of untreated timber and show the composition and density of the marine wood borer population. New untreated samples must be installed at intervals as long as the trial is running in order to follow variations in species and population density.

After a sufficient period of drying and preservative fixation, the samples were placed at random on 8 specially-built frames, fig. 4. On this ladder-like frame the samples are hung on six rungs. The distance between the samples on the rungs is around 2.5 cm. The frames were placed on the bottom at a depth of 6 m.

The samples were examined for the first time in November 1972 at which time they had been exposed in the water for five months. Thereafter examinations have been made late in the autumns of 1973 and 1974. It is intended to examine the samples at one-year intervals during the first five-year period. Later, intervals of two or three years will probably be chosen.

The samples are at first examined for attack by *Limnoria*. The amount of superficial fouling organisms is also observed and registered. After removal of the fouling organisms, the panels are then x-rayed by means of Philips Macrotank K 100/Be. It is operated at 3 m A and 40 kV for an exposure time varying between 0.5 and 2.5 min., depending on the type of film used.

The calcarious tunnels, shells and pallets of the shipworms give a contrast effect on the x-ray film. The extent of the damage within the samples is thereby easily evaluated, (Fisher 1940, Crips 1953, Oliver 1959, Fougerousse 1968, 1970, 1971). It has been proved that the animals are not damaged by the x-ray procedure or by exposing the samples to the air for a few hours.

According to the NWPC Standard No 1.4.2.2/73 the attack by *Limnoria* and the *Teredos* together is evaluated using the following grading system:

Condition	Index of attack
No attack	0
Slight attack	1/3
Moderate attack	2/3
Sample destroyed	1

Each sample is evaluated separately and for each series of six samples an average index of attack has been calculated. When all panels in one series has been rejected (samples destroyed) and the attack reaches index 1, the average service life of the series can be determined.

RESULTS AND DISCUSSION

Most of the preservatives tested are copper-containing multi salts which are generally known for their effectiveness against marine borers (McQuire 1971). It was therefore not expected that the treated samples were to be extensively attacked during the first years of exposure. And, as can be seen from the summarized results for the autumn inspections in 1972 - 1974 (tab. 1 - 3), only little attack was really noted on the treated samples. In Scots pine, attack by shipworms has been noted only in the lower retentions of two and in all retentions of one of the tested preservatives. In European beech, attack has been noted on the lower retentions of one and in European birch in both of the tested preservatives. The untreated controls, however, were seriously attacked already after 5 month's exposure. They were destroyed primarily by shipworms. New controls had to be installed in the autumn of 1973. Attack by *Limnoria* occurred only on the untreated controls after an exposure of more than one year. In 1974 the population of *Teredo navalis* was very low at Kristineberg Marine Biology Station which may explain the low index of attack of the untreated controls in 1974, table 1, 2 and 3 (Norman 1975).

At the inspection in 1972 the surface fouling organisms were dominated by algae and ascidians. The samples were, however, not entirely covered by fouling organisms. In 1973 the fouling had very markedly increased. Barnacles and ascidians dominated. The fouling was less on samples of Scots pine treated with preservatives no. 1 and 2.

The short distance, 2.5 cm, between the individual samples on the frame has been submitted to discussion. It has been argued that leaching products from one sample could influence the attack on neighbouring samples. However, a comparison between control samples from various sites on the frame does not support that argument. Untreated panels placed next to panels treated to the highest retentions do not deviate in the extent of attack from other control samples placed outermost on a rung or between samples treated to low retentions. We therefore believe that water streams between the samples to a sufficient degree to eliminate any chemical influence between adjacent samples.

Preservative No.	Type	Retention kg/m^3	Average index of attack Nov 1972	Oct. 1973	Nov. 1974
1	Cu-PCP NH_3	23.7	0	0.20	0.33
		35.2	0	0	0.06
		47.6	0	0	0
		58.3	0	0	0
		70.9	0	0	0
2	Cu-org.acid NH_3	23.5	0	0.39	0.89
		35.4	0	0.22	0.50
		48.1	0	0.17	0.50
		60.7	0	0	0.11
		71.1	0	0	0.11
3	CCA	17.5	0	0	0.06
		25.4	0	0	0
		35.5	0	0	0
		44.5	0	0	0
		52.7	0	0	0
4	CCA	18.6	0	0	0
		26.4	0	0	0
		36.0	0	0	0
		45.1	0	0	0
		51.3	0	0	0
5	CC	20.4	0	0	0
		33.1	0	0	0
		43.3	0	0	0
		53.9	0	0	0
		67.6	0	0	0
6	CCA	17.1	0	0	0
		25.6	0	0	0
		35.7	0	0	0
		44.5	0	0	0
		54.3	0	0	0
7	CCB	21.5	0	0	0
		31.5	0	0	0
		43.0	0	0	0
		54.3	0	0	0
		64.3	0	0	0
8	CCB	20.8	0	0	0
		31.8	0	0	0
		43.0	0	0	0
		52.0	0	0	0
		63.3	0	0	0
9	CCP	13.7	0	0	0
		20.5	0	0	0
		27.1	0	0	0
		34.3	0	0	0
		41.8	0	0	0
10	CCA	13.8	0	0	0
		21.5	0	0	0
		26.4	0	0	0
		34.8	0	0	0
		42.0	0	0	0

Preservative No.	Type	Retention kg/m^3	Average index of attack Nov. 1972	Oct. 1973	Nov. 1974
11	CCA	13.6	0	0	0
		21.5	0	0	0
		27.9	0	0	0
		35.8	0	0	0
		42.3	0	0	0
12	CCAP	13.5	0	0	0
		20.5	0	0	0
		27.4	0	0	0
		36.0	0	0	0
		43.4	0	0	0
13	CCP	14.0	0	0	0
		21.4	0	0	0
		28.9	0	0	0
		36.4	0	0	0
		42.6	0	0	0
Control, untreated			0.98	1.0	0.43

Tab. 1. Type of preservative, retention and average index of attack for impregnated panels of Scots pine *(Pinus silvestris)* submerged for 2.5 years (3 summers) at Kristineberg Marine Biology Station in Sweden.

Preservative No.	Type	Retention kg/m^3	Average index of attack Nov. 1972	Oct. 1973	Nov. 1974
1.	Cu-PCP NH_3	21.7	0	0	0.39
		35.6	0	0	0.06
		45.7	0	0	0
		60.1	0	0	0
		68.3	0	0	0
2.	CCA	13.3	0	0	0
		20.1	0	0	0
		27.2	0	0	0
		36.0	0	0	0
		41.5	0	0	0
Control, untreated			0.94	1	0.61

Table 2. Type of preservative, retention and average index of attack for impregnated panels of European beech *(Fagus silvatica)* submerged for 2.5 years (3 summers) at Kristineberg Marine Biology Station in Sweden.

Preservative No.	Type	Retention kg/m^3	Average index of attack Nov. 1972	Oct. 1973	Nov. 1974
1.	Cu-PCP NH_3	22.9	0	0	0.11
		34.4	0	0	0.06
		46.8	0	0	0
		59.1	0	0	0
		70.0	0	0	0
2.	CCA	12.9	0	0	0.22
		19.4	0	0	0.17
		27.7	0	0	0
		33.0	0	0	0
		38.3	0	0	0
Control, untreated			0.94	1	0.33

Table 3. Type of preservative, retention and average index of attack for impregnated panels of European birch *(Betula verrucosa)* submerged for 2.5 years (3 summers) at Kristineberg Marine Biology Station in Sweden.

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SWEDISH SUMMARY

Nordiska Träskyddsrådet (NTR) påbörjade år 1972 en undersökning vid Kristinebergs Marinbiologiska Station (fig 1, 2) rörande olika impregneringsmedels förmåga att skydda virke i havet mot angrepp av skeppsmask och borrkräfta. I samband med undersökningen utarbetades en nordisk standardmetod för denna typ av provningar. (NWPC Standard Nr. 1.4.2.2/73). På försökslokalen förekommer skeppsmaskarterna *Teredo navalis* L. *Psiloteredo megotara* H. samt borrkräftan *Limnoria lignorum* R.

Ohyvlade prover, 2.5 x 7.5 x 20 cm, av tall *(Pinus silvestris* L.), bok *(Fagus silvatica)* och björk *(Betula verrucosa* Ehrh.), tryckimpregnerades enligt metod beskriven i NWPC Standard Nr. 1.4.2.2/73. Tretton impregneringsmedel användes på tall och två medel på bok och björk. Fem koncentrationer per impregneringsmedel användes (tab 1, 2 och 3). I försöket ingick även 18 oimpregnerade prover av tall och 6 av bok och björk. Proverna placerades efter slumptabell på 8 försöksställningar, som ställdes på havsbotten på 6 meters djup (fig 4). Proverna undersöktes efter 5 månader, i november 1972 samt på hösten 1973 och 1974. Nya oimpregnerade prover sattes ut på hösten 1973. Proverna undersöktes först beträffande angrepp av *Limnoria*. Därefter röntgenfotograferades de. På röntgenfilmen erhålles en bild av skador förorsakade av skeppsmask inne i provet. Skadorna av *Limnoria* och skeppsmask bedömdes sammantagna enligt skalan 0, 1/3, 2/3 och 1. (NWPC Standard Nr. 1.4.2.2/73). 0 betyder att provet är oangripet och vid 1 blir provet utdömt. I tabellerna 1 - 3 anges medelvaraktighet för 6 prover per koncentration av de olika impregneringsmedlen.

Vid 1972 års revision var de oimpregnerade proverna svårt angripna, medan samtliga impregnerade prover saknade angrepp.

1973 fanns angrepp av skeppsmask på tallprover impregnerade med Cu-PCP NH_3 och Cu-org. acid NH_3 vid låga koncentrationer. Nya kontrollprover utsattes i stället för de utdömda proverna från 1972.

1974 förekom angrepp i tallprover impregnerade med "Cu-org. acid-NH_3" vid samtliga koncentrationer och med "Cu-PCP-NH_3" samt ett CCA medel vid låga koncentrationer. Bokprover och björkprover impregnerade med

"Cu-PCP-NH_3",samt björkprover med CCA var angripna vid de två lägsta koncentrationerna. De oimpregnerade var inte lika svårt angripna som på hösten 1972, vilket berodde på låg populationstäthet år 1974 hos den vanligaste skeppsmaskarten *Teredo navalis* (Tab 1, 2 och 3).

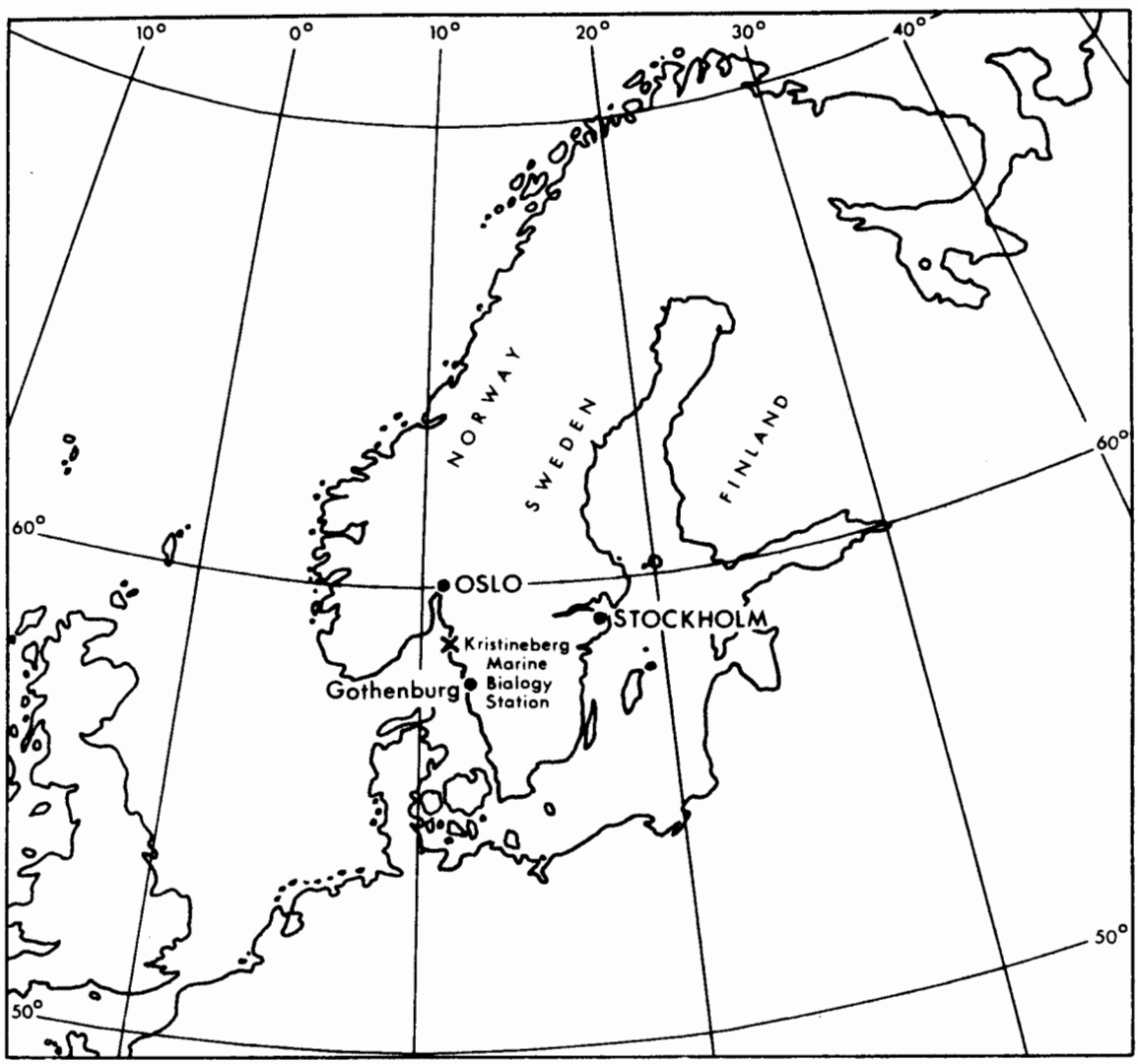

Fig. 1. The geographical location of the Kristineberg Marine Biology Station.

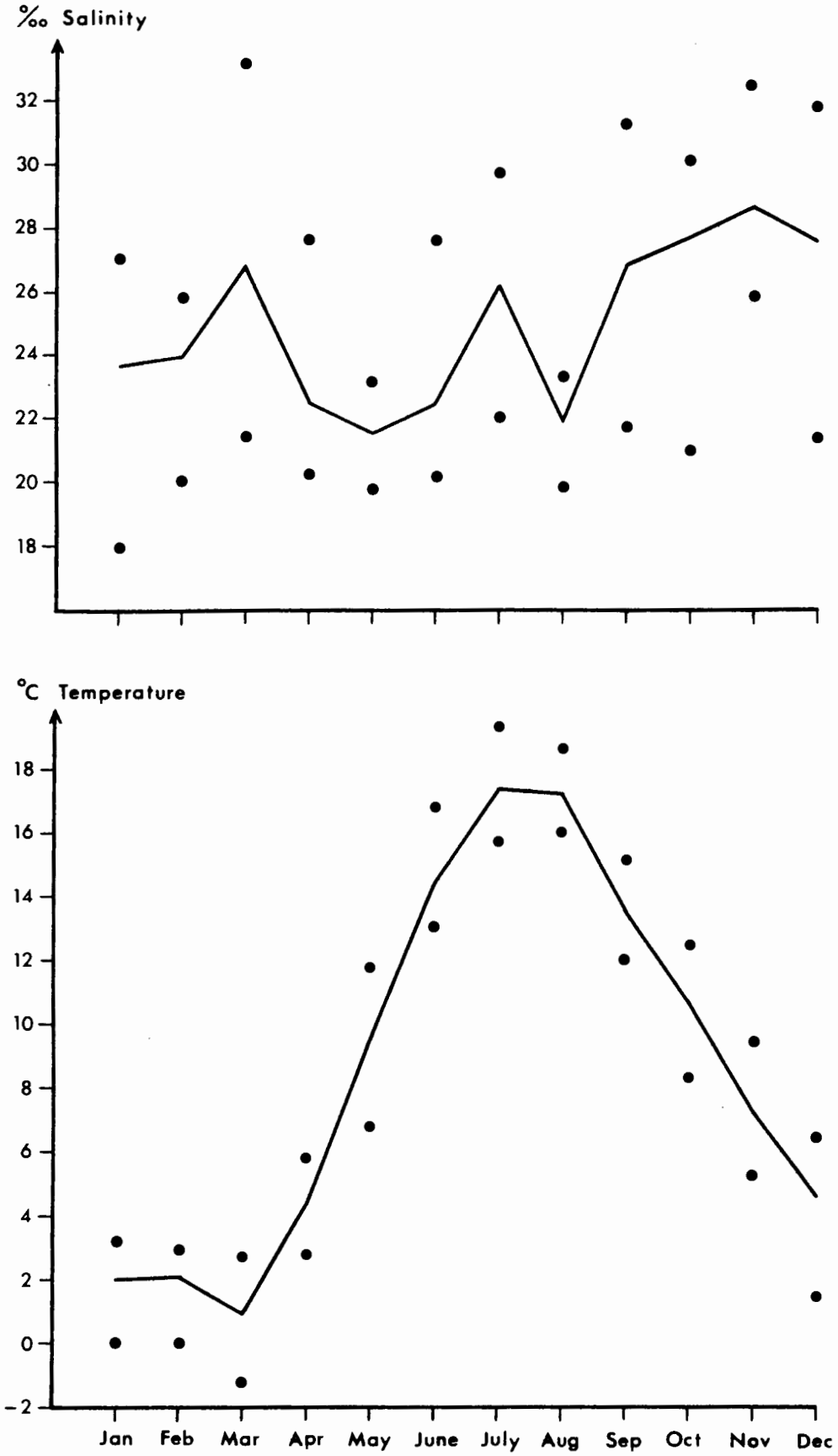

Fig. 2. The monthly mean, maximum and minimum salinity and temperature readings of the surface water at Kristineberg Marine Biology Station in 1971.

Fig. 3. Test block of Scots pine *(Pinus silvestris* L.) impregnated with preservative no. 2 (tab. 1) to a retention of 23.5 kg/m^3. Inspected in November 1974.

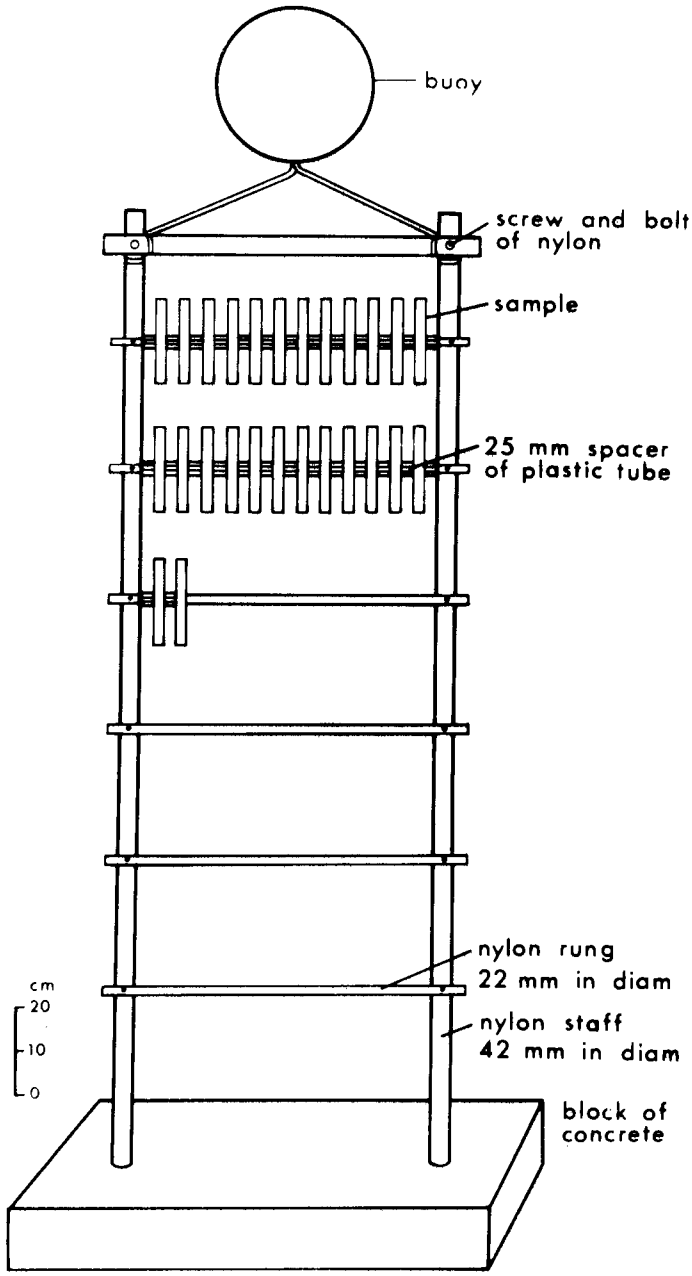

Fig. 4. The arrangement of the test blocks.