

waterloopkundig laboratorium

Stroomsluis Noordland in
de Oosterscheldedam

ontgrondingsonderzoek

verslag modelonderzoek

M 1201 deel II

november 1974

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de Oosterscheldedam

ontgrondingsonderzoek

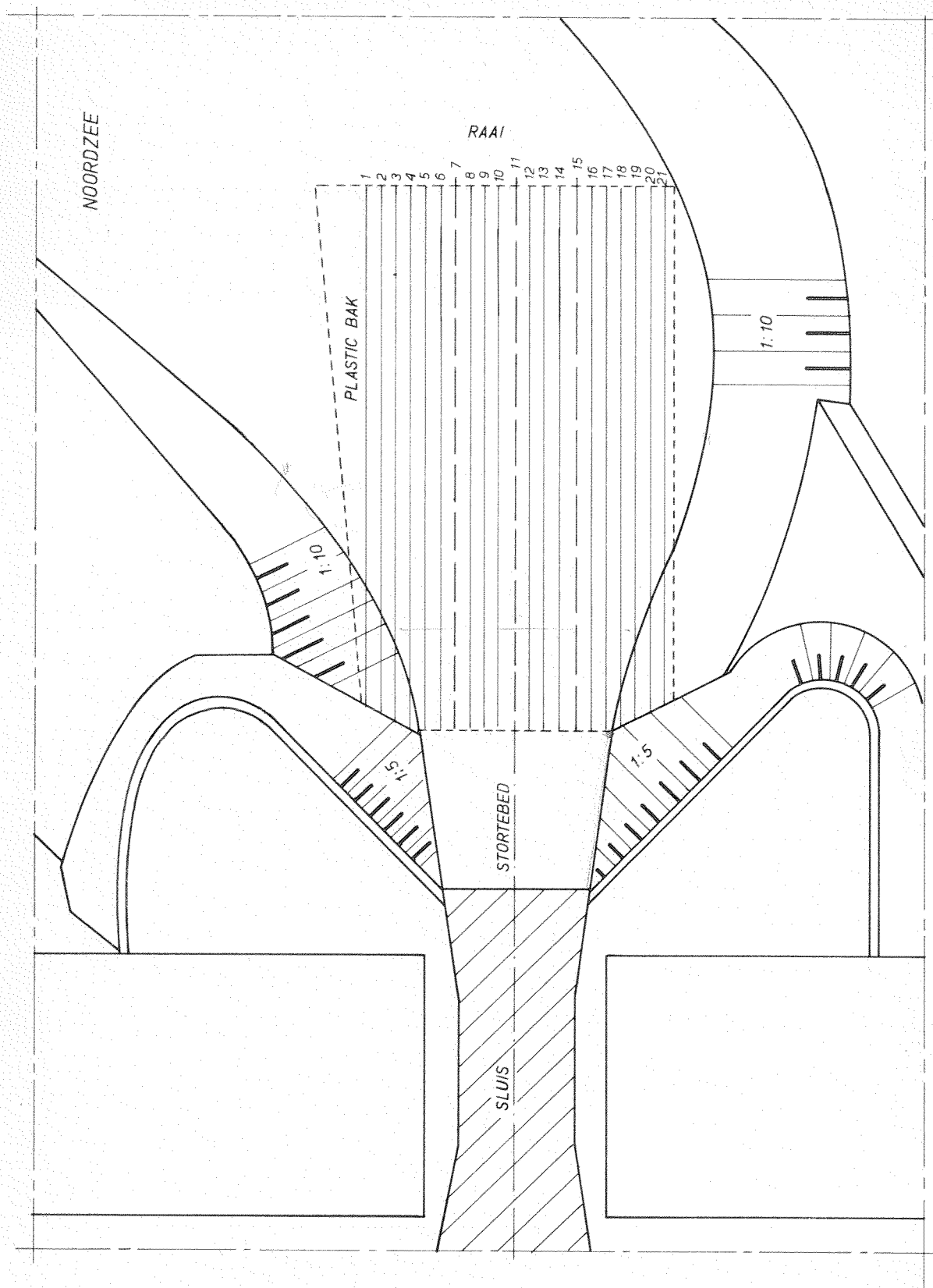
verslag modelonderzoek

M 1201 deel II

november 1974

BIJLAGEN ONTGRONDINGSONDERZOEK M1201 DEEL II

II - 1	Situatie langsraaien
II - 2	Stroombeeld (foto)
II - 3 t/m 24	Tijd-ontgrondingslijnen
II - 25 t/m 84	Ontgrondingsbeelden, langs- en dwarsdoorsneden van de kuilen
II - 85 t/m 96	Vertikale snelheidsverdelingen
II - 97 t/m 101	Horizontale gemiddelde snelheidsverdelingen
II -102 t/m 113	Meetresultaten principeproef met retourstroming bij verticale beëindiging



SITUATIE LANGSRAAIEN

SCHAAL 1:4000

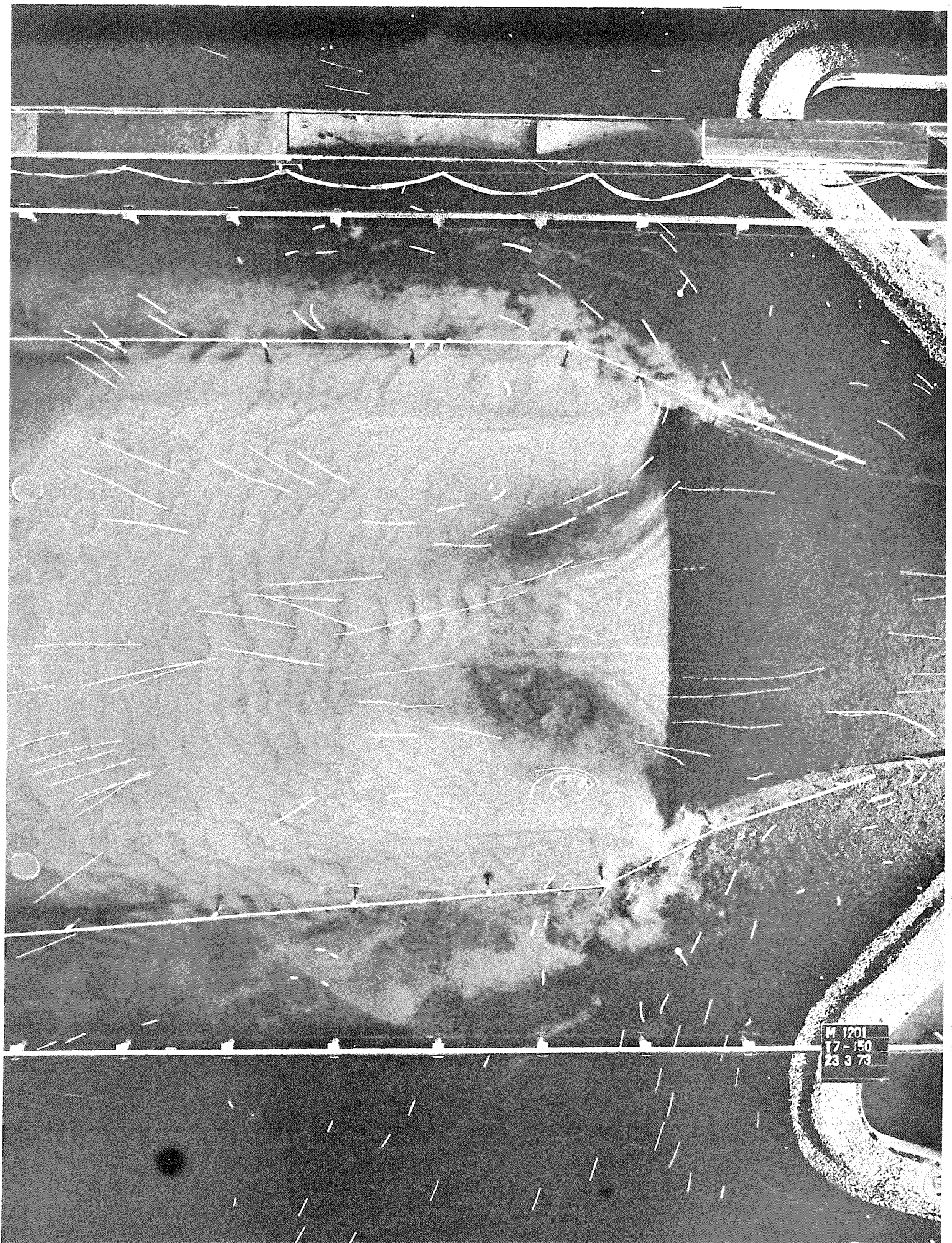
WK

A4

WATERLOOPKUNDIG LABORATORIUM

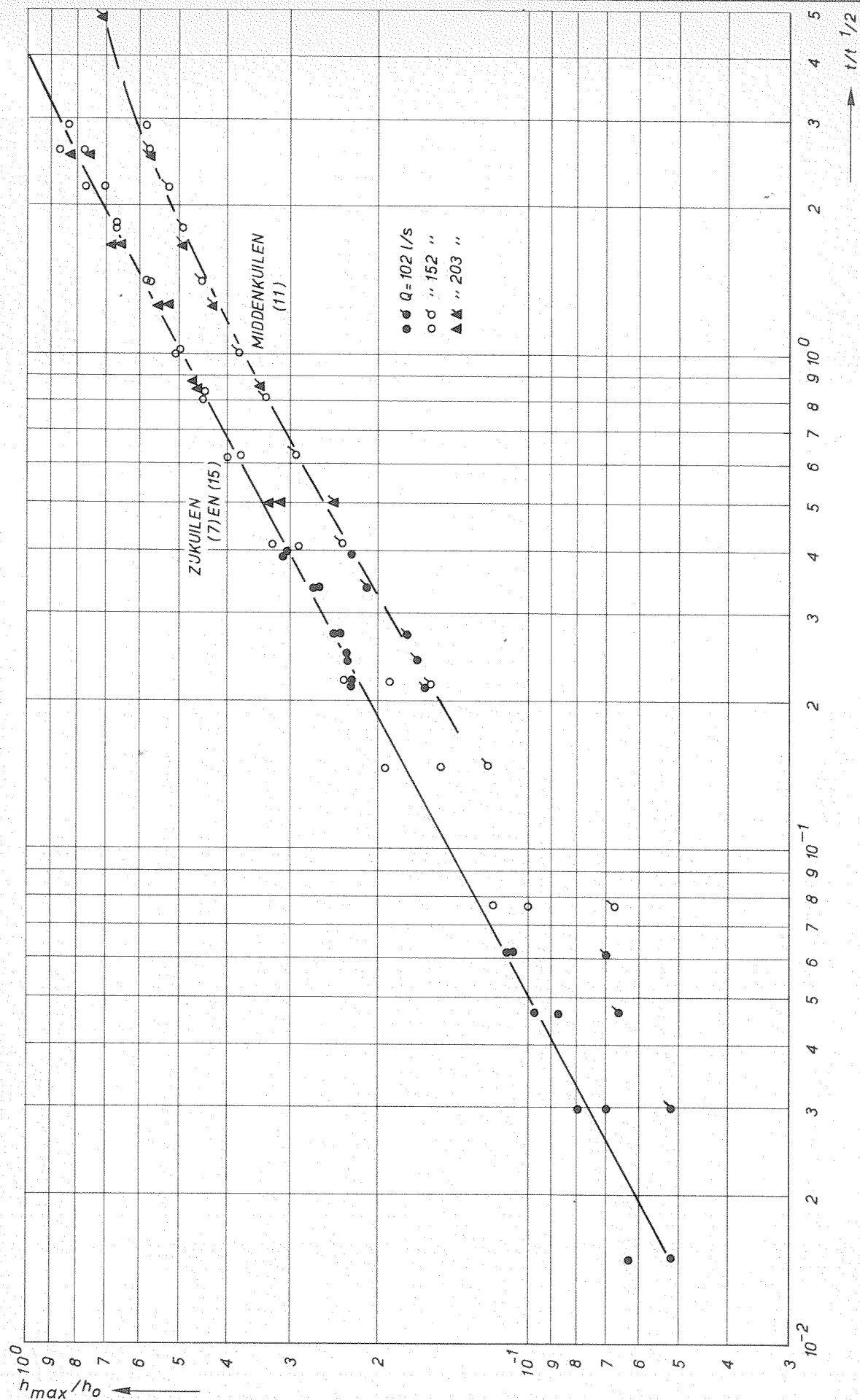
M. 1201- 1002

FIG.II-1



M 1201
17-150
23 3 73

STROOMBEELD



TUD - ONTGRONDINGSLIJNEN T_1

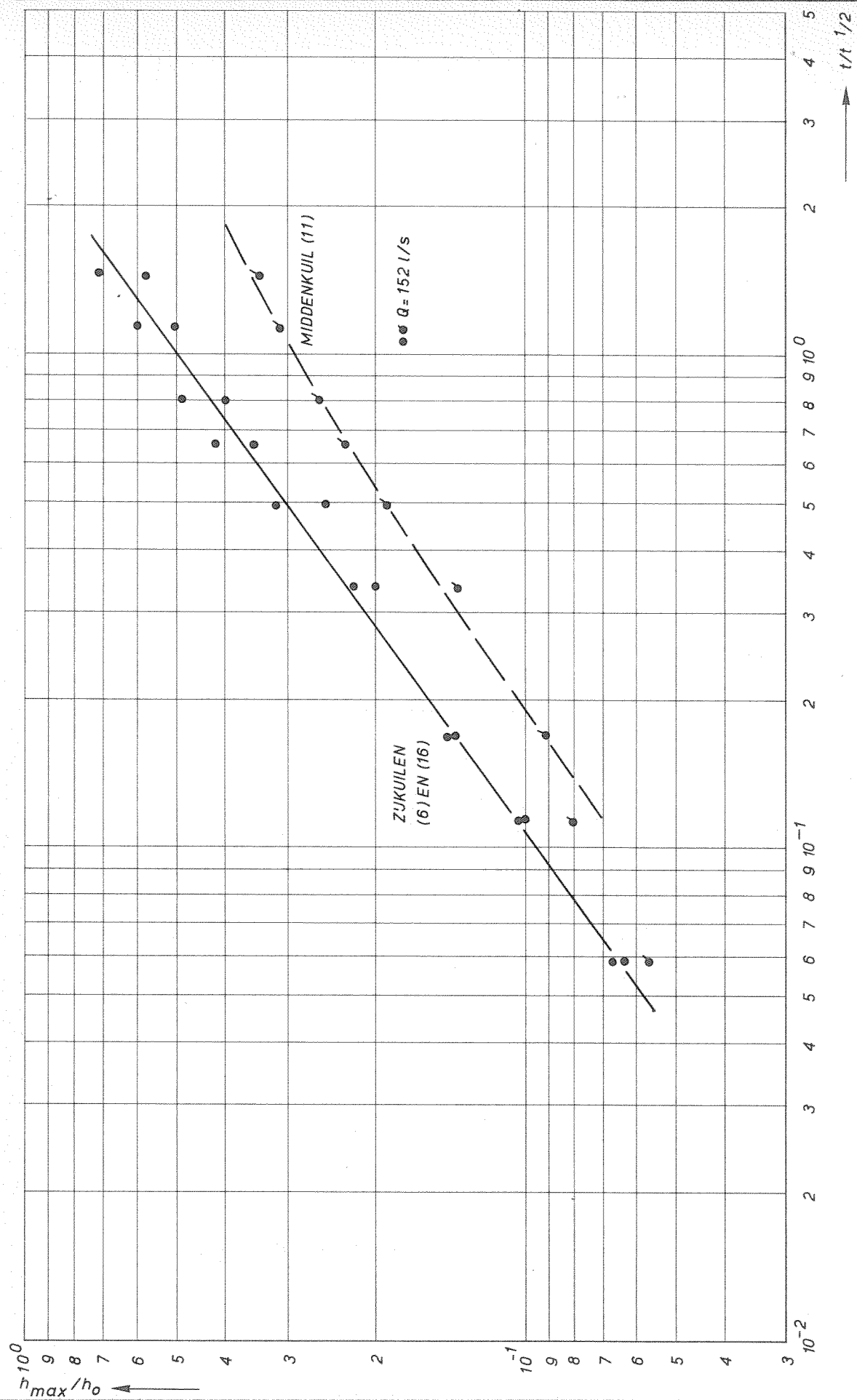
WATERLOOPKUNDIG LABORATORIUM

M.1201-1007

FIG. II-3

WK

A4



TJD - ONTGRONDINGSLIJNEN T_2

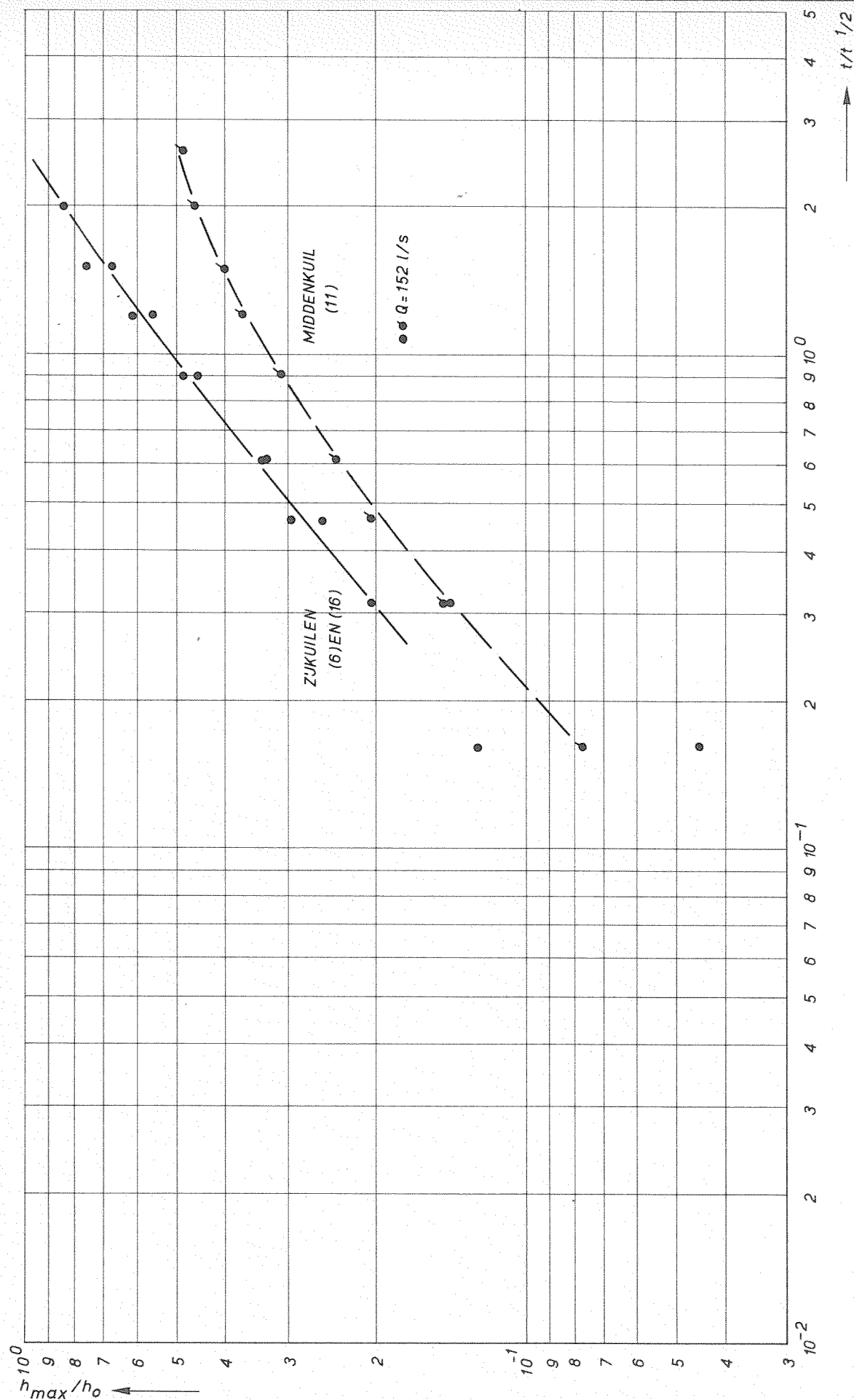
WK

A4

WATERLOOPKUNDIG LABORATORIUM

M.1201-1008

FIG. II-4



TJD - ONTGRONDINGSLUNEN T_3

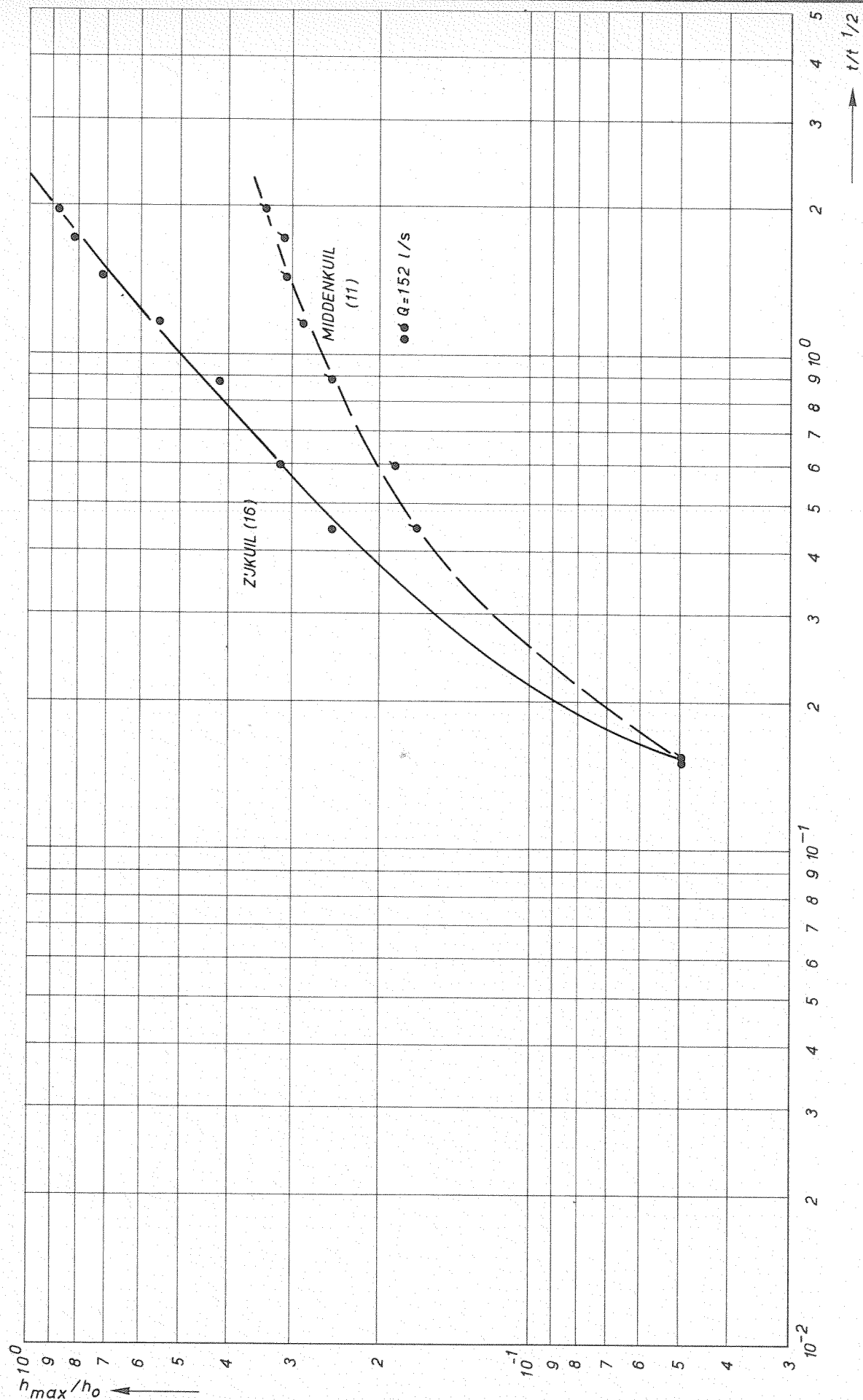
WATERLOOPKUNDIG LABORATORIUM

M. 1201-1009

FIG. II-5

WK

A4



TJD - ONTGRONDINGSLUNEN T_4

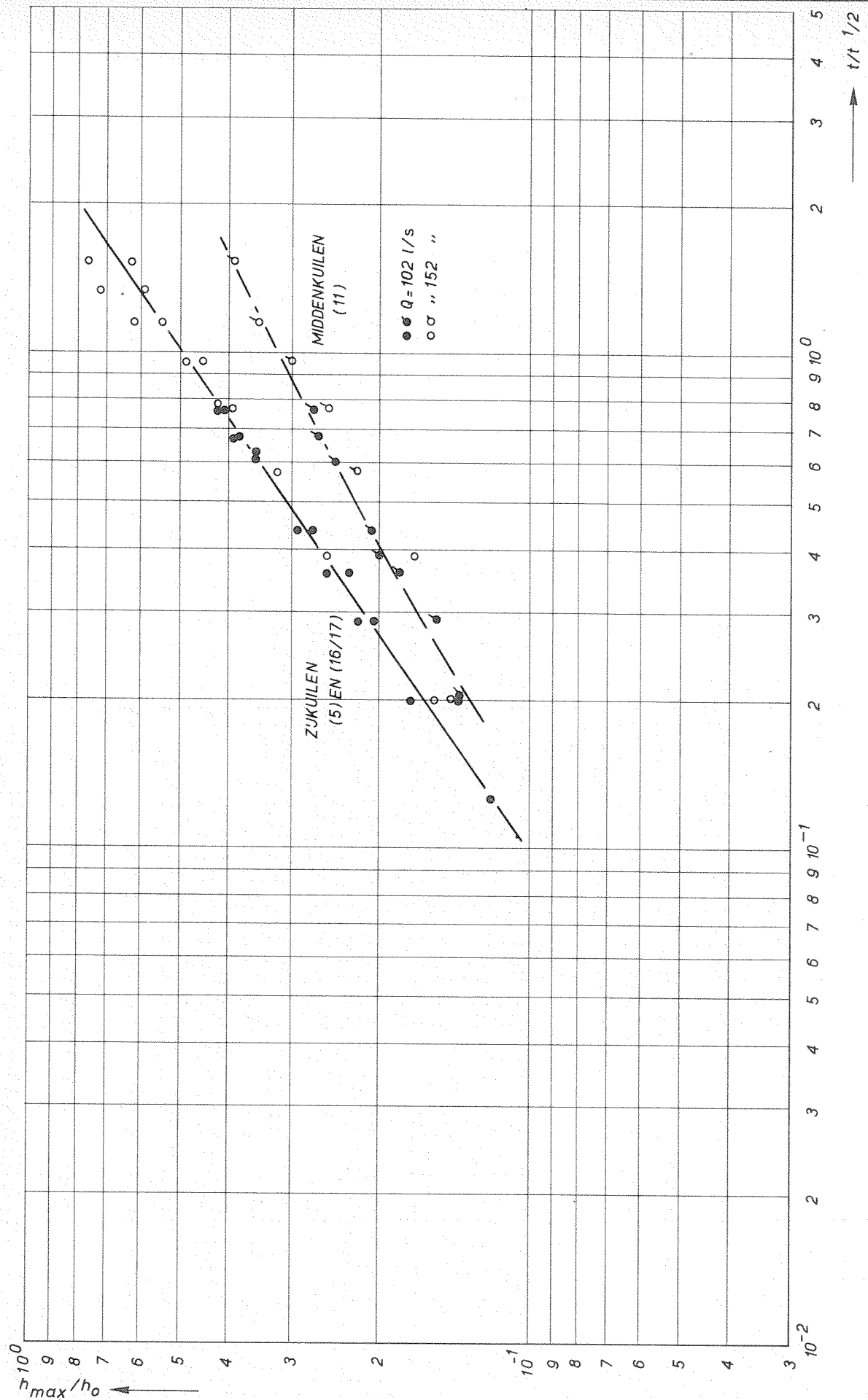
WATERLOOPKUNDIG LABORATORIUM

M.1201-1010

FIG.II-6

WK

A4



TUD - ONTGRONDINGSLUNEN T_5

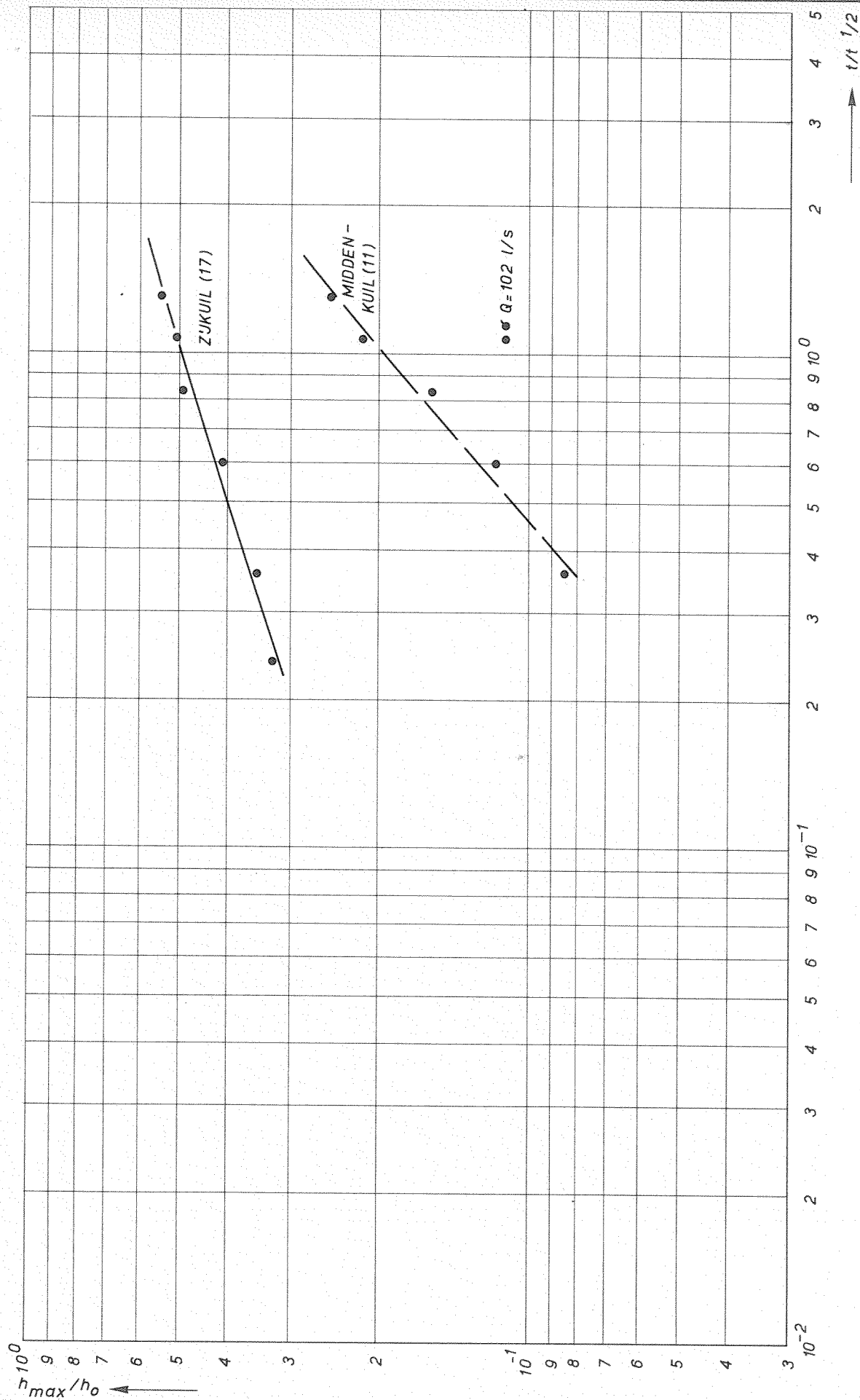
WATERLOOPKUNDIG LABORATORIUM

M. 1201-1011

FIG. II - 7

WK

A4



TJD - ONTGRONDINGSLUNEN T_5^A

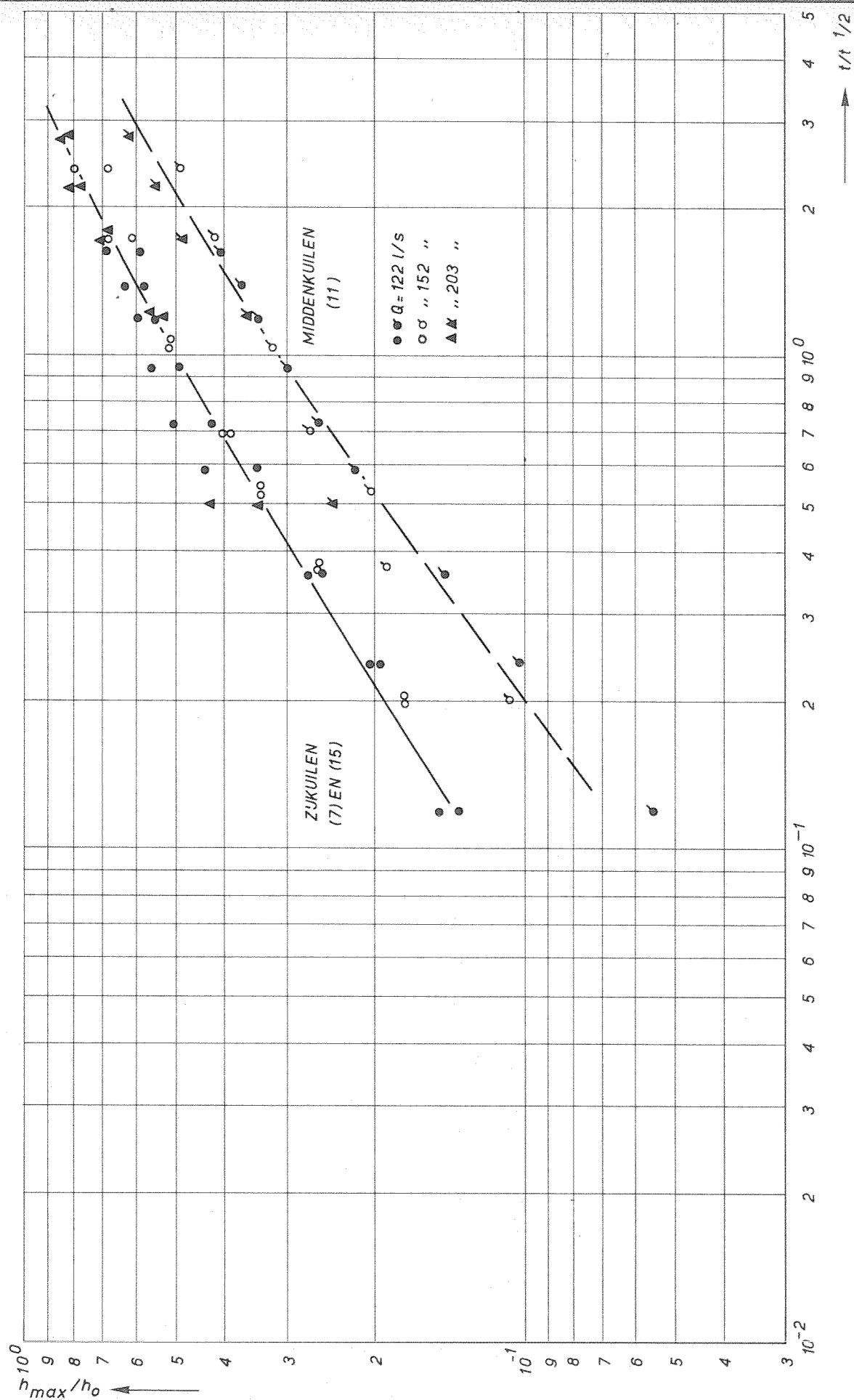
WK

A4

WATERLOOPKUNDIG LABORATORIUM

M. 1201-1012

FIG. II-8



TJD - ONTGRONDINGSLIJNEN T_6

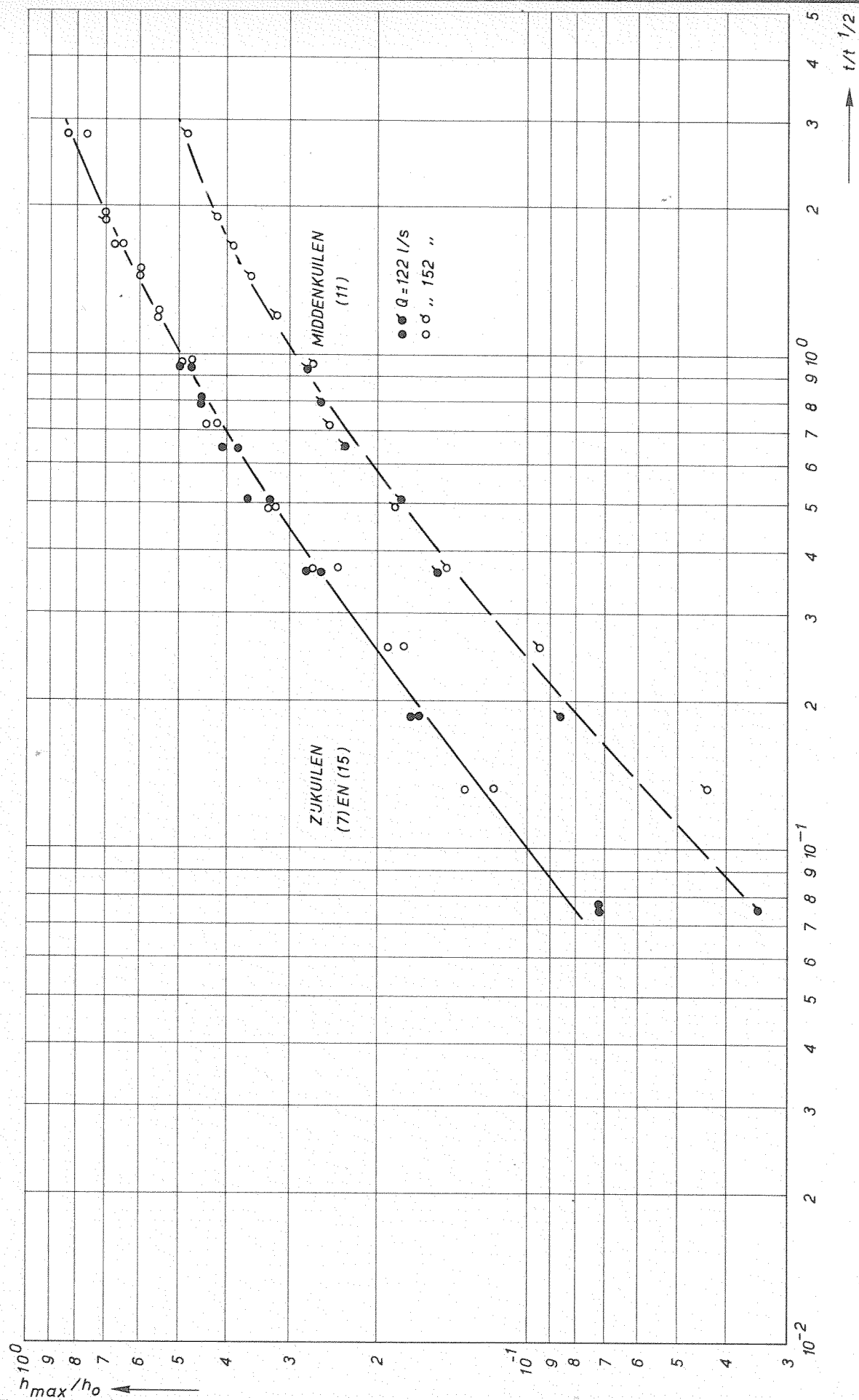
WATERLOOPKUNDIG LABORATORIUM

M.1201-1013

FIG.II- 9

WK

A4



TJD - ONTGRONDINGSLIJNEN T_7

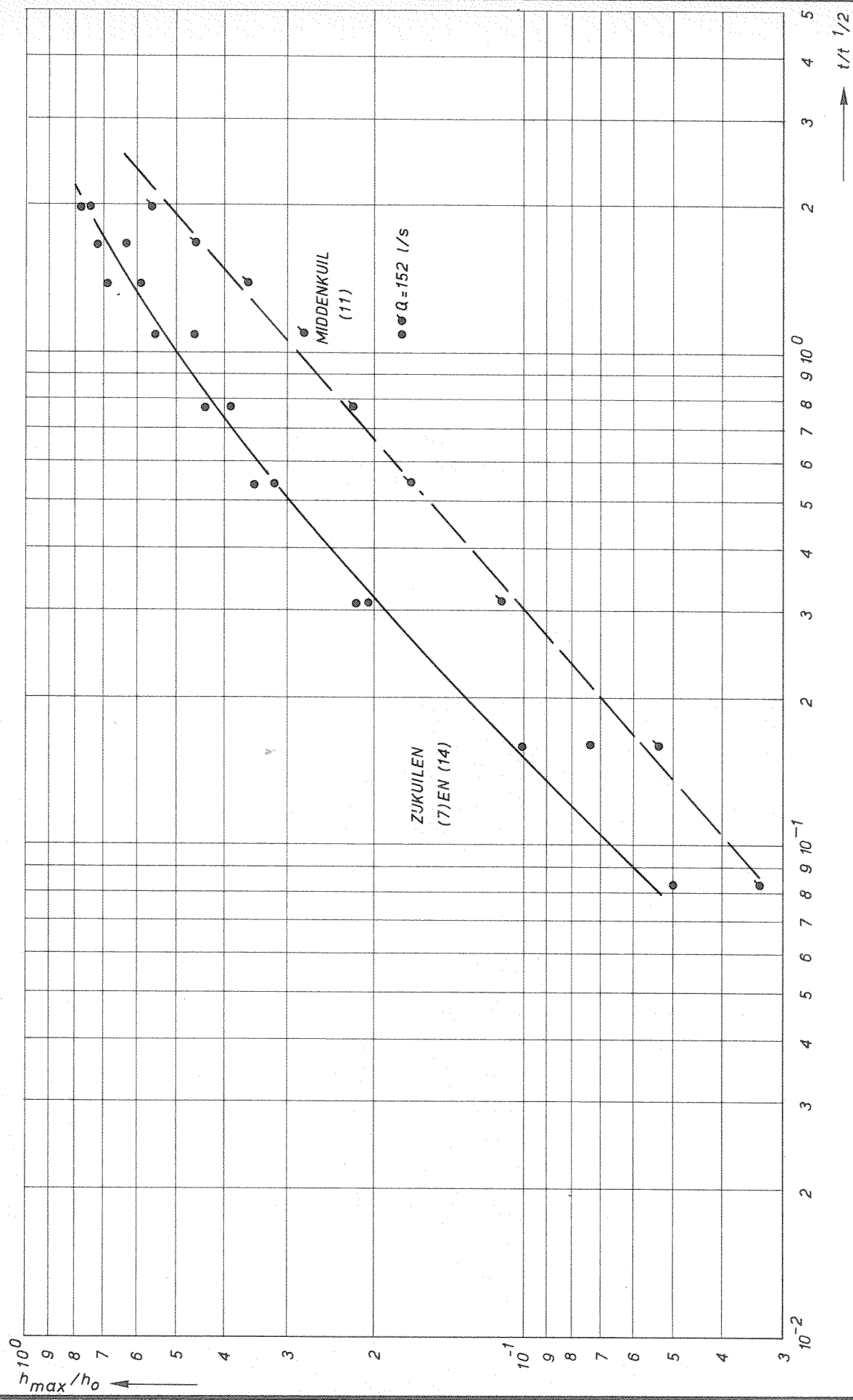
WK

A4

WATERLOOPKUNDIG LABORATORIUM

M. 1201-1014

FIG. II-10



TUD - ONTGRONDINGSLIJNEN T_7^A

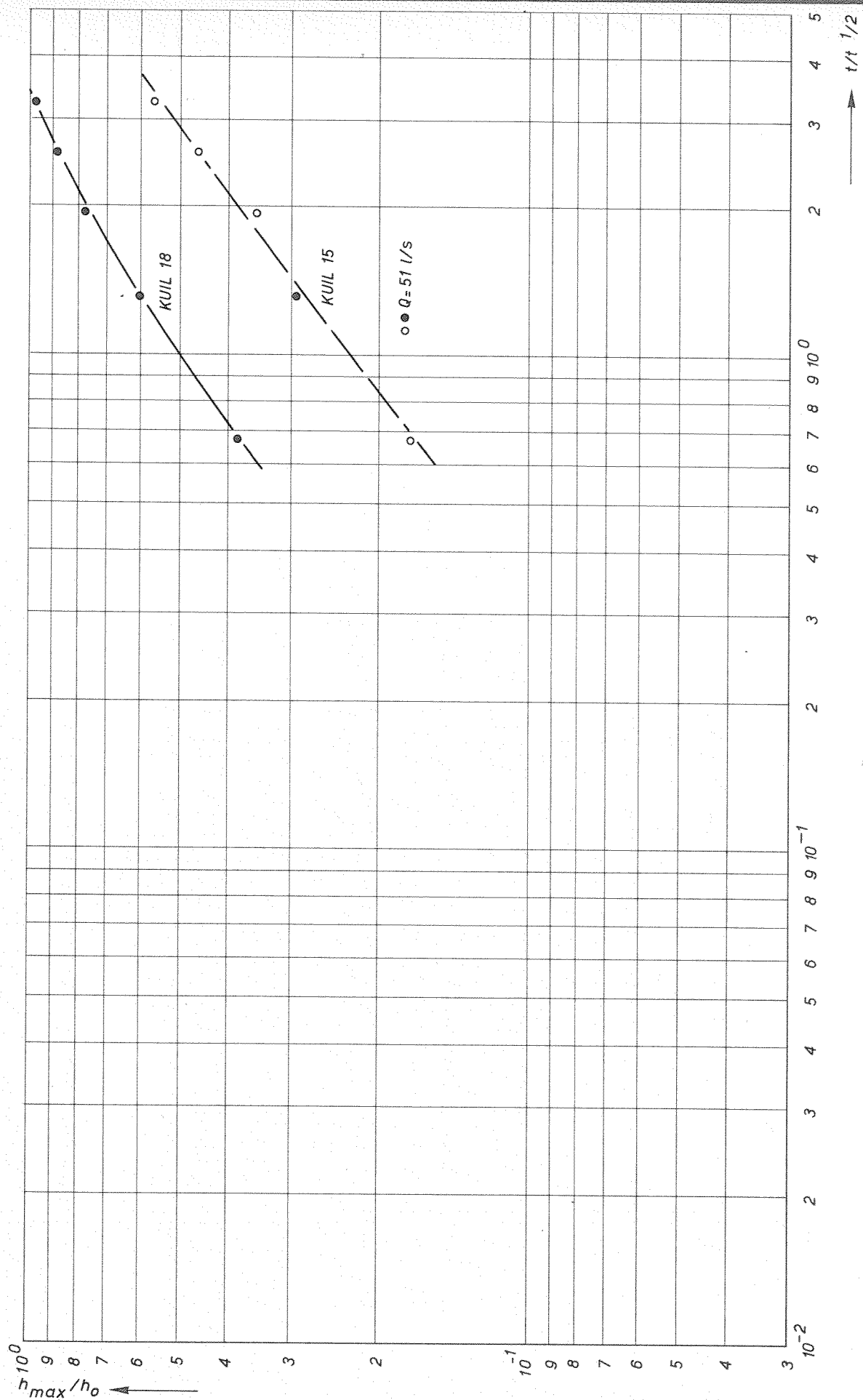
WATERLOOPKUNDIG LABORATORIUM

M. 1201-1015

FIG. II - 11

WK

A4



TJD - ONTGRONDINGSLUNEN T_7^B

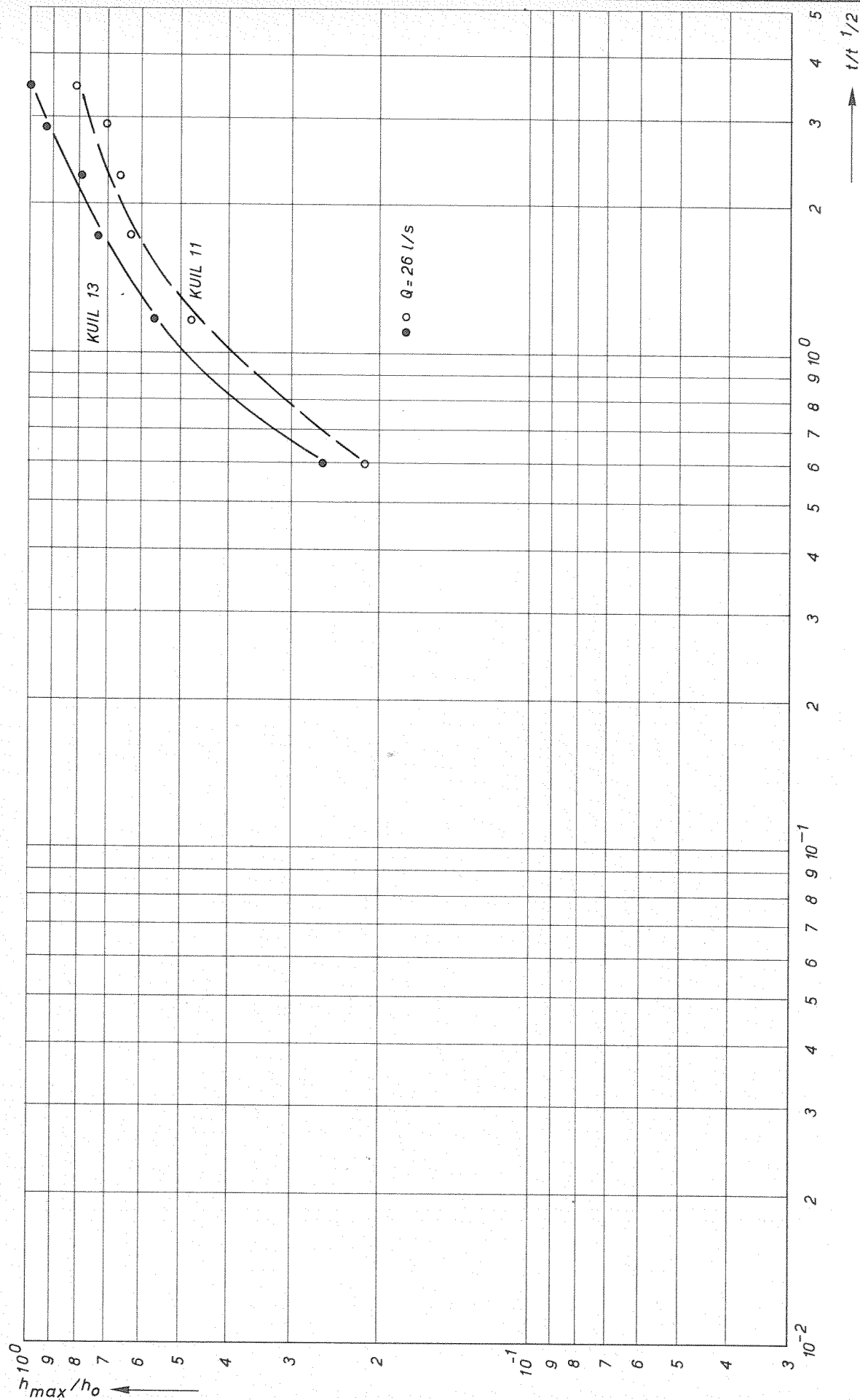
WATERLOOPKUNDIG LABORATORIUM

M. 1201- 1016

FIG. II-12

WK

A4



TJD - ONTGRONDINGSLUNEN T_7^c

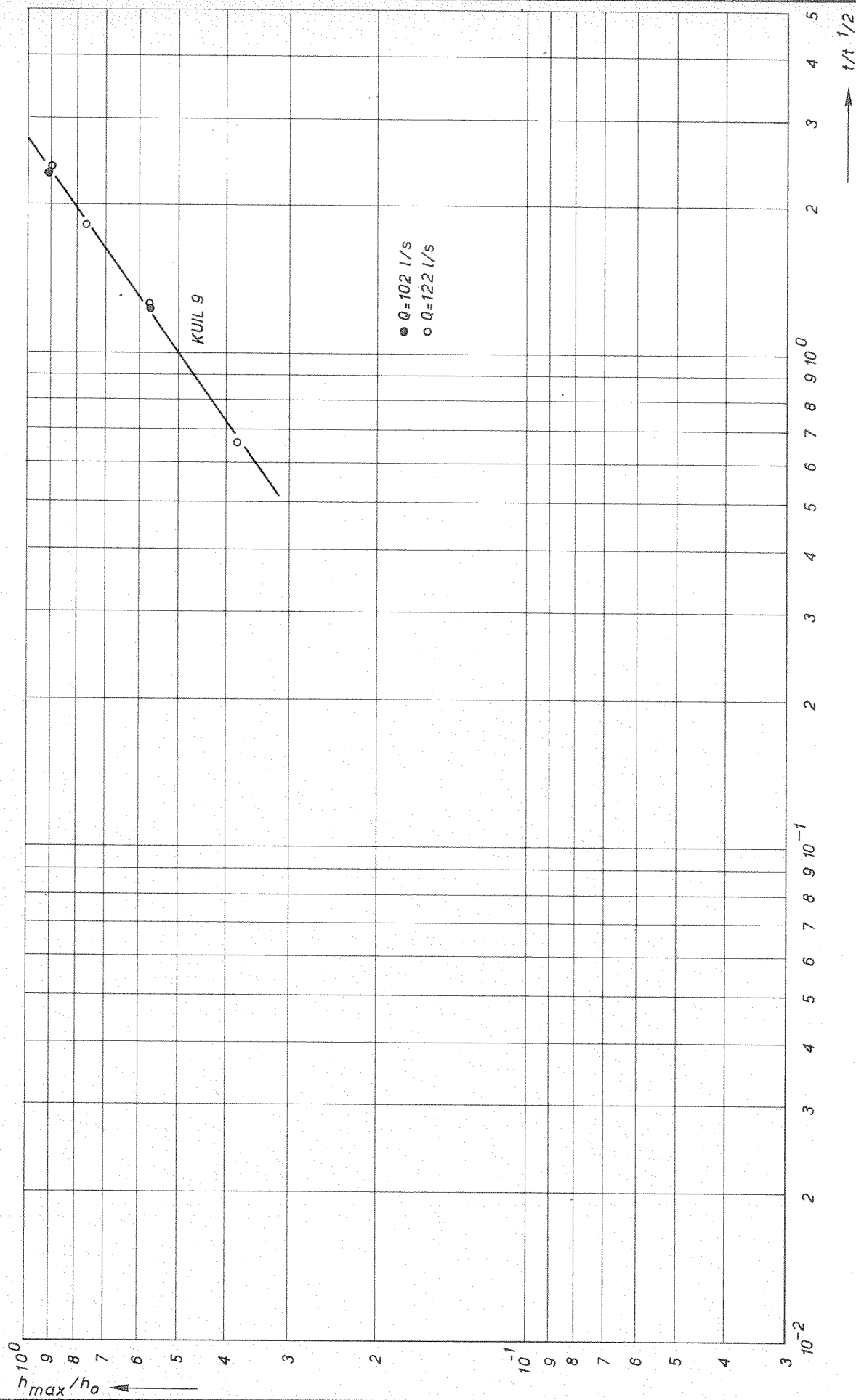
WATERLOOPKUNDIG LABORATORIUM

M. 1201-1017

FIG. II-13

WK

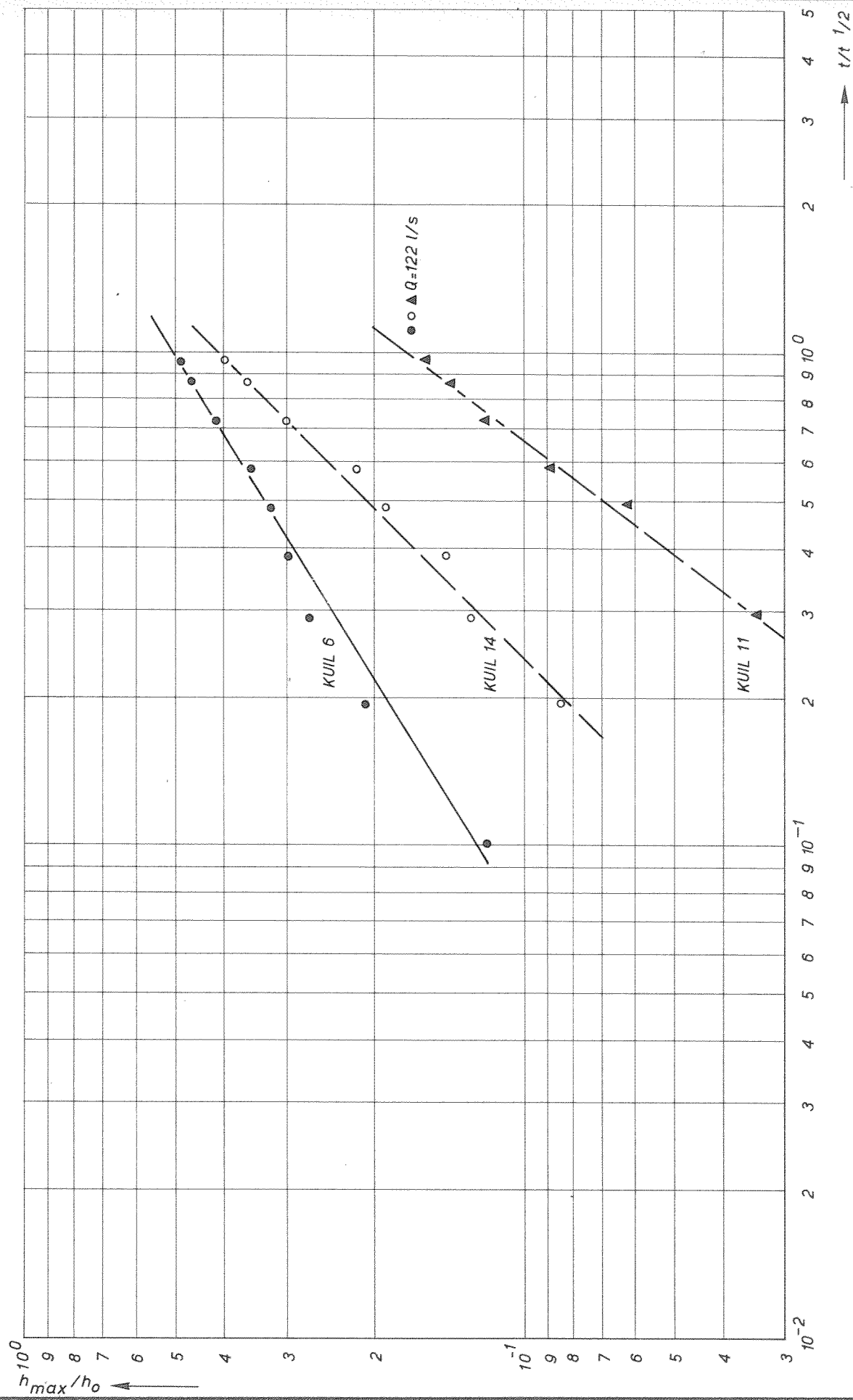
A4



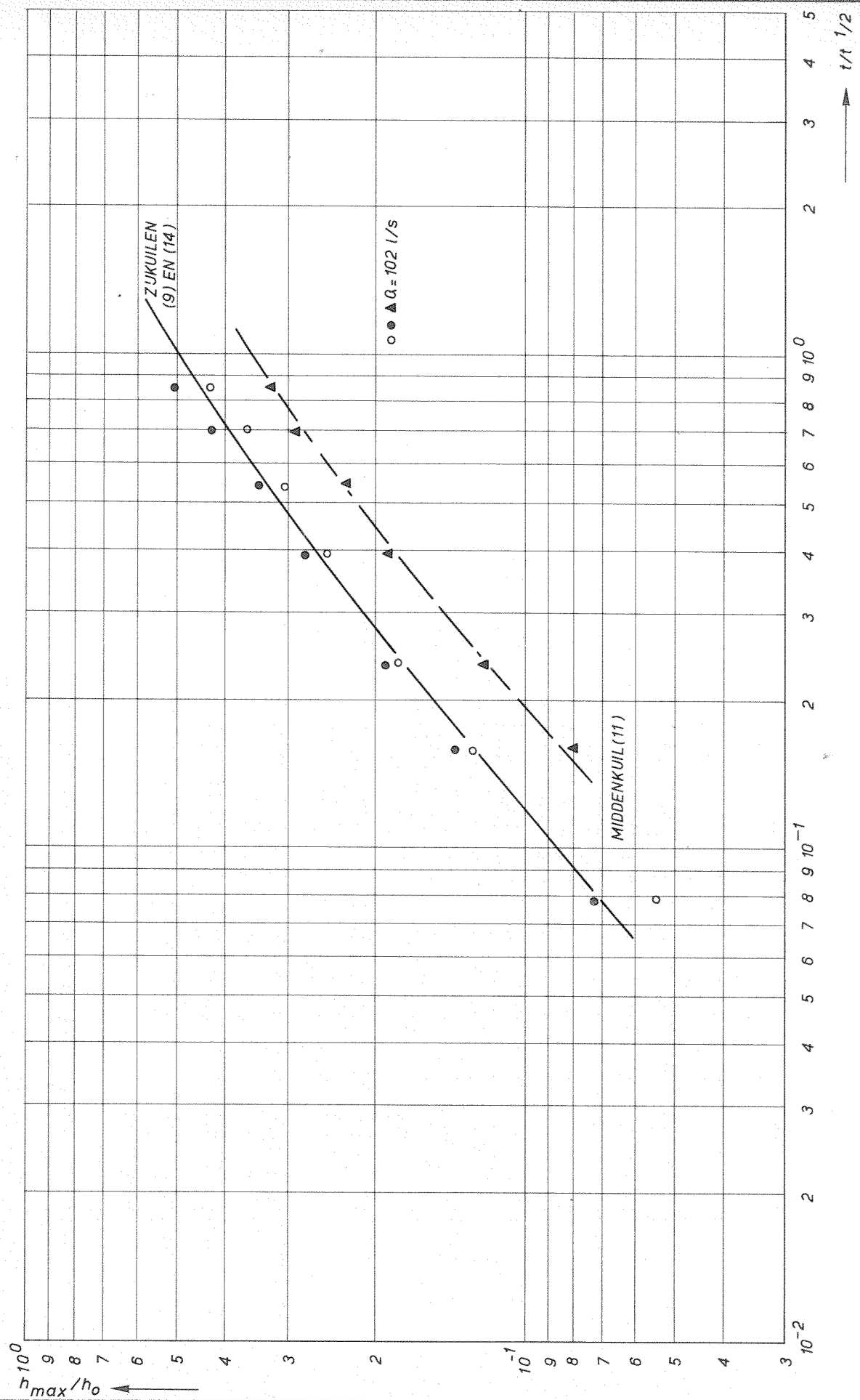
TJD - ONTGRONDINGSLIJNEN T_{7D}

WK

A4



TJD - ONTGRONDINGSLIJNEN T_7^E



TJD - ONTGRONDINGSLIJNEN T_7^F

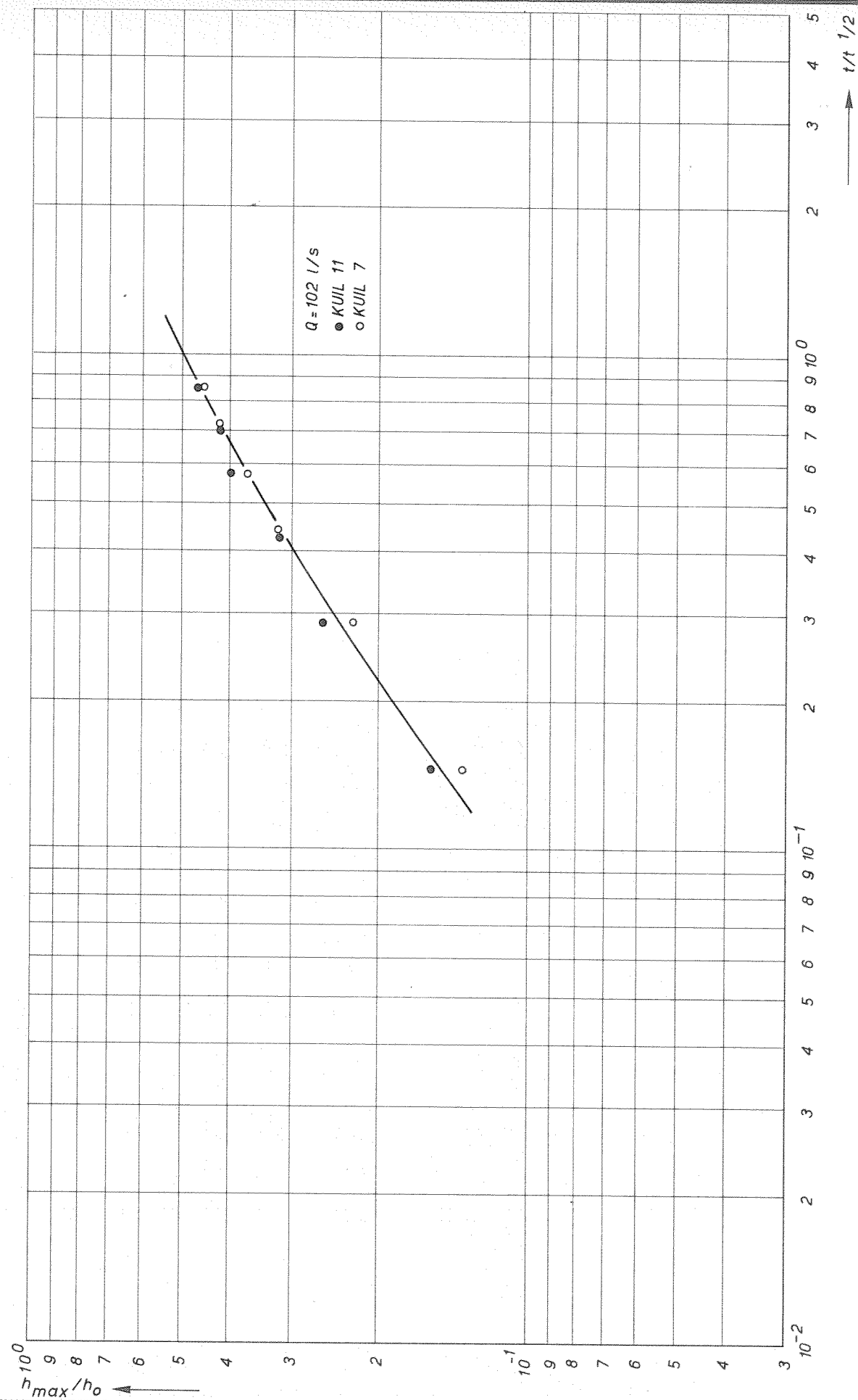
WK

A4

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M. 1201-1020

FIG. II-16



TJD - ONTGRONDINGSLUNEN T_7^G

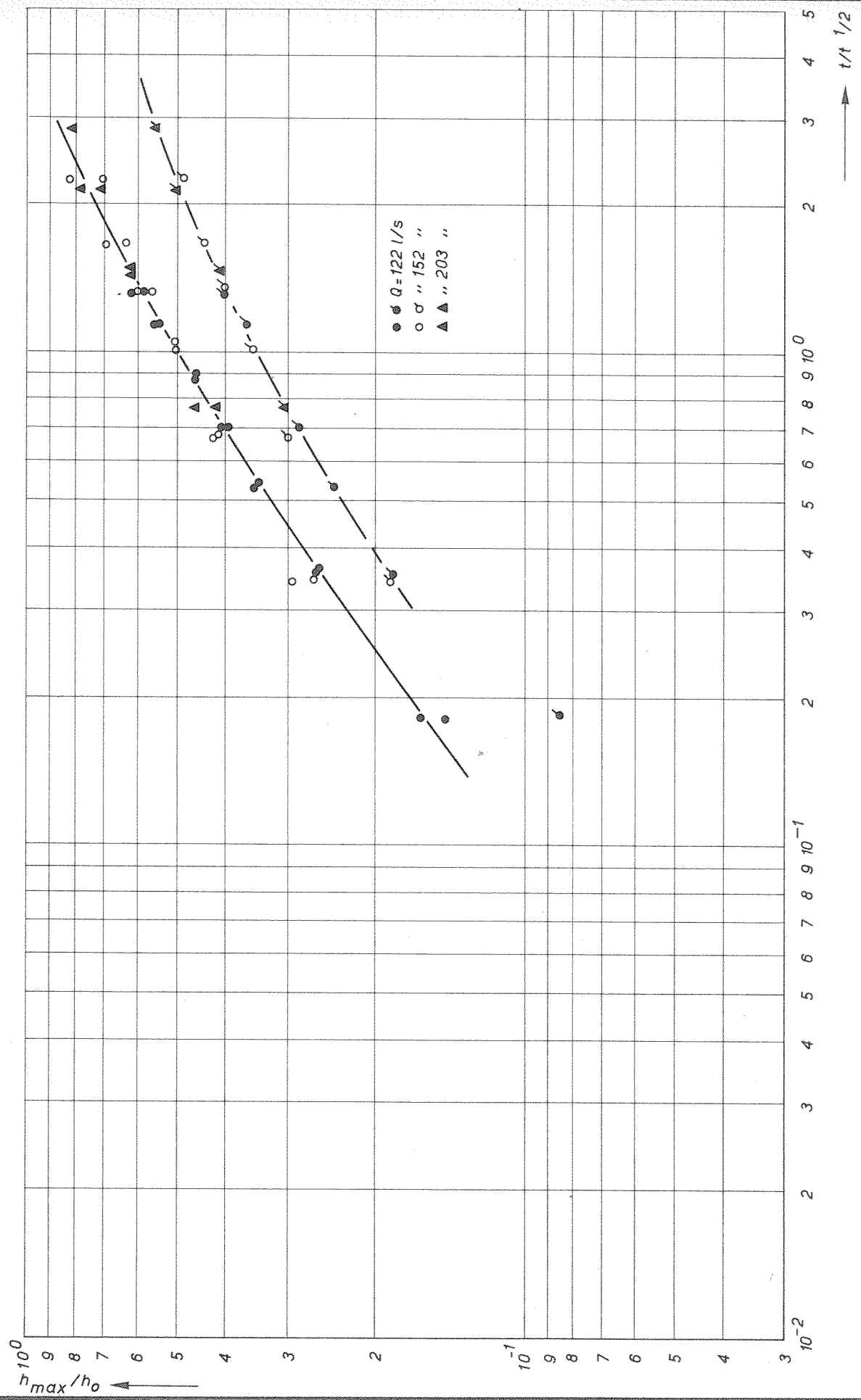
WATERLOOPKUNDIG LABORATORIUM

M.1201- 1021

FIG. II-17

WK

A4



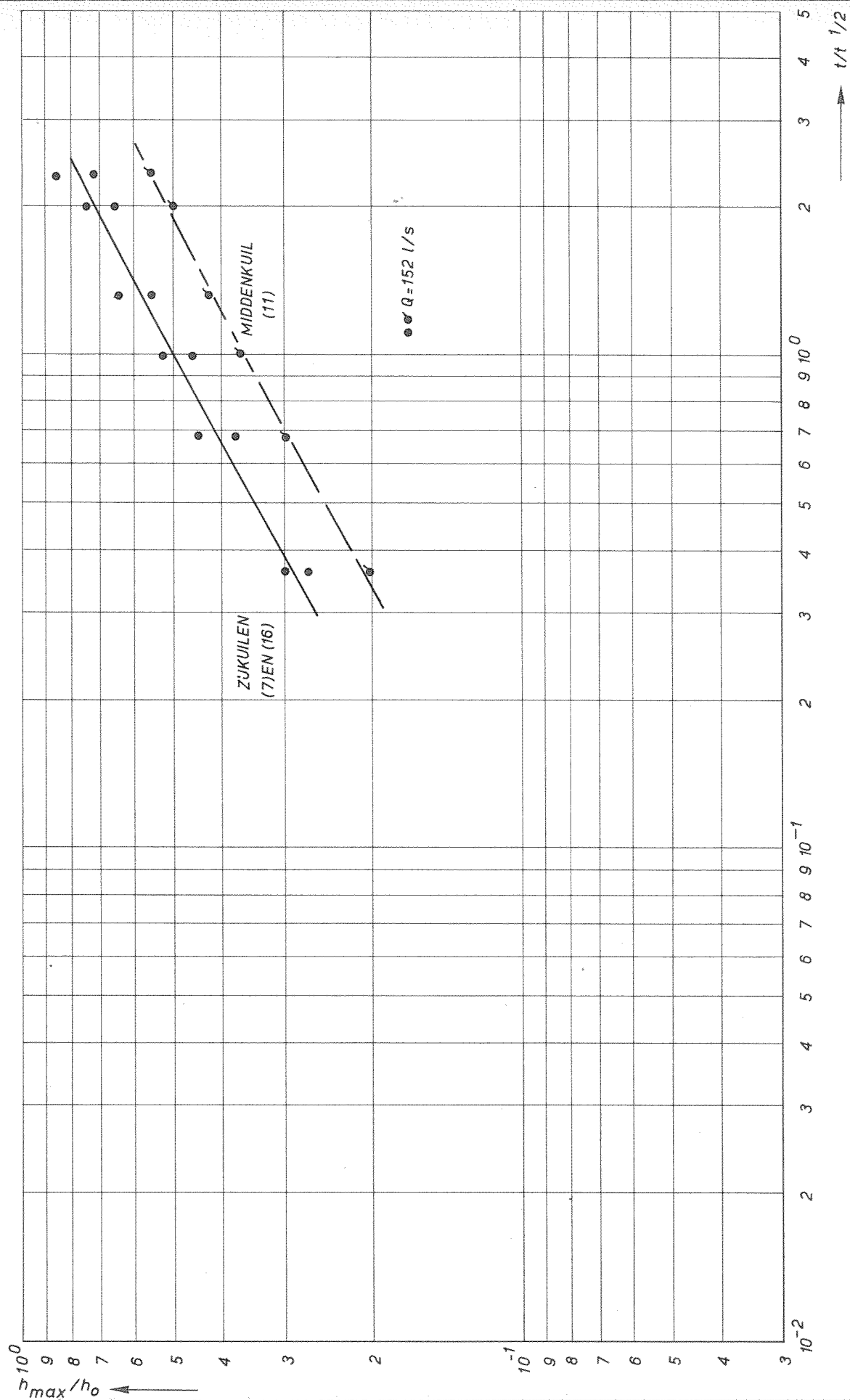
TJD - ONTGRONDINGSLIJNEN T_8

WATERLOOPKUNDIG LABORATORIUM

M. 1201- 1022 FIG. II-18

WK

A4



TJD - ONTGRONDINGSLIJNEN T_{8A}

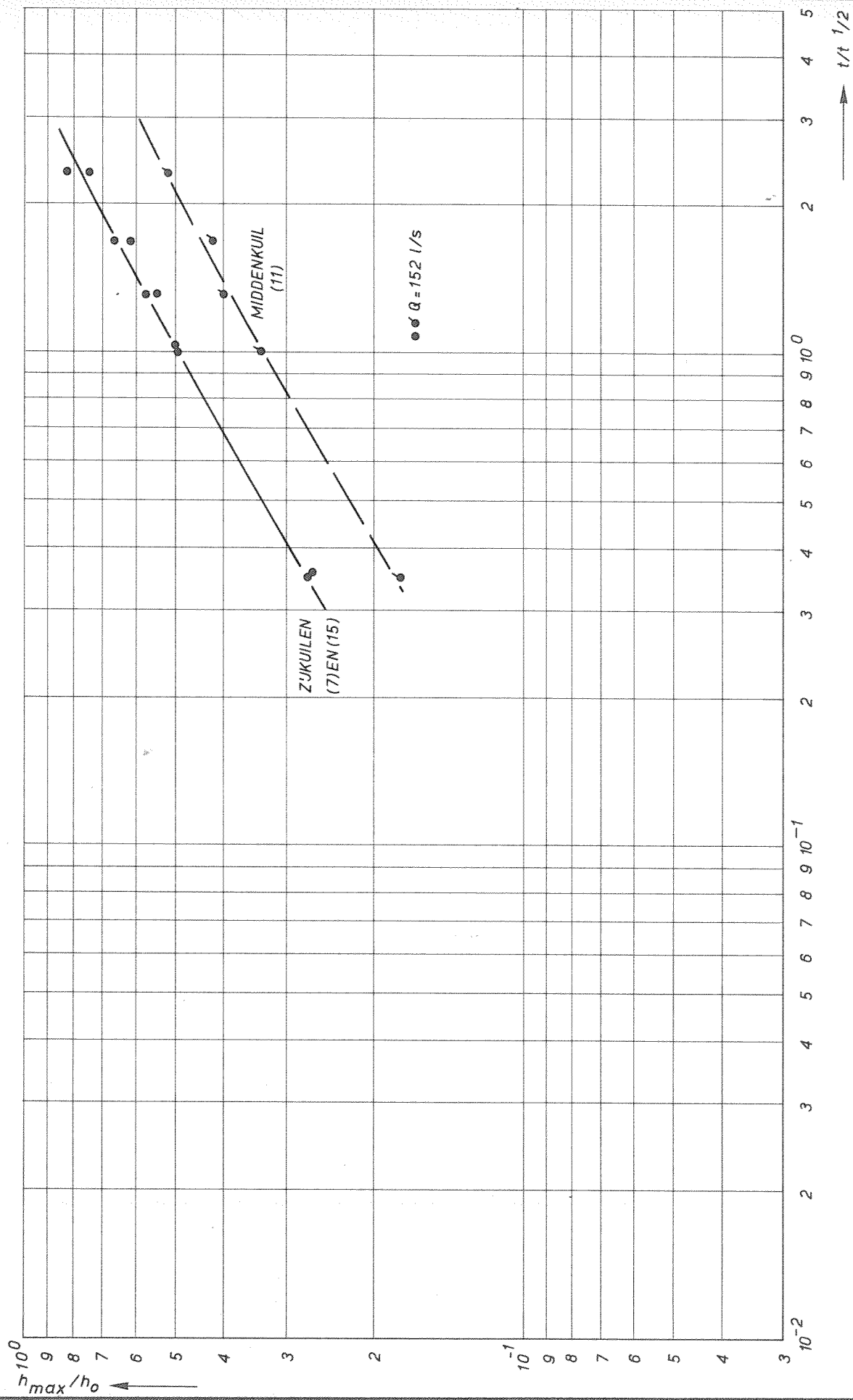
WATERLOOPKUNDIG LABORATORIUM

M. 1201-1023

FIG. II - 19

WK

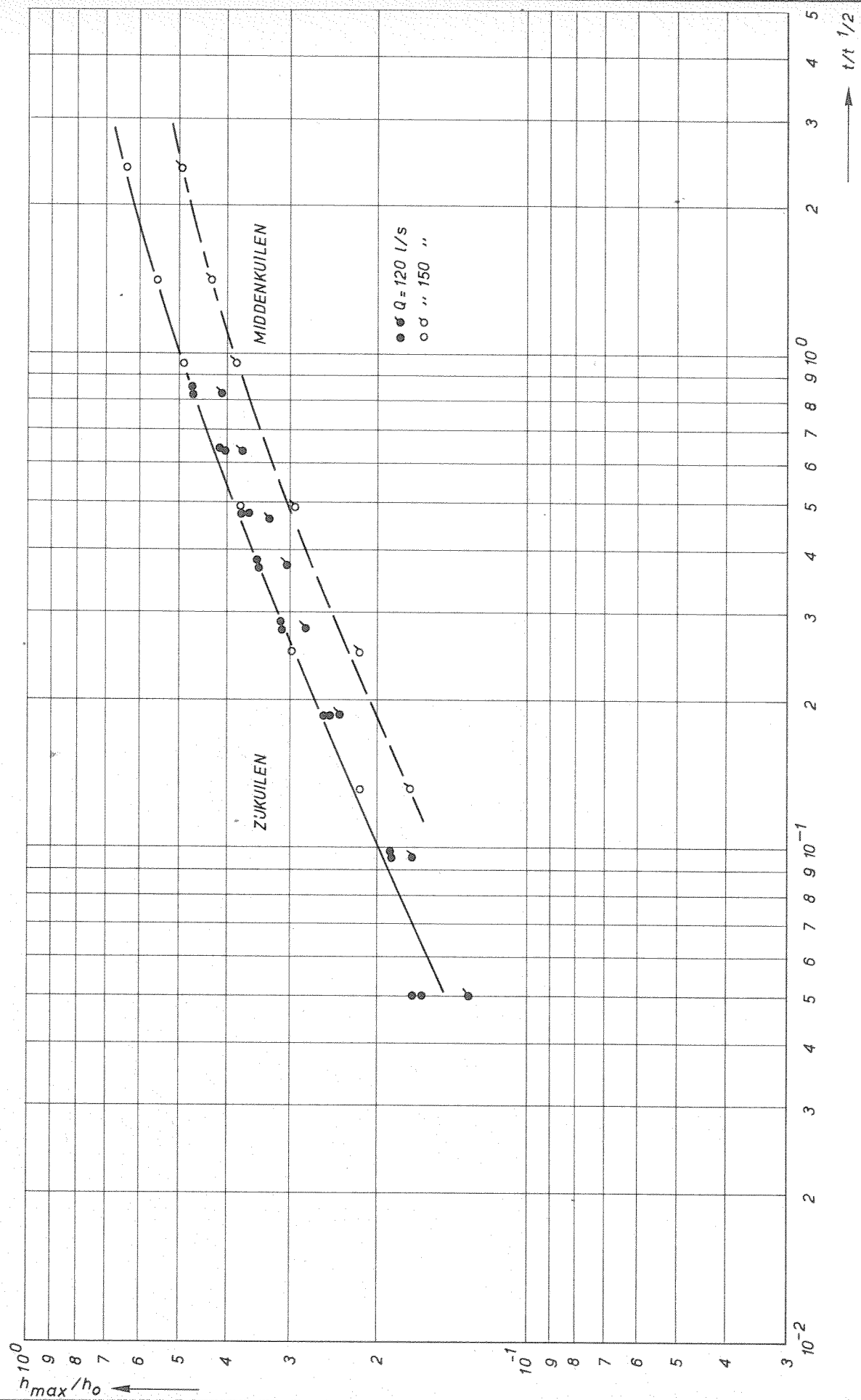
A4



TJD - ONTGRONDINGSLIJNEN T_{0B}

WK

A4



TUD - ONTGRONDINGSLUNEN T_9

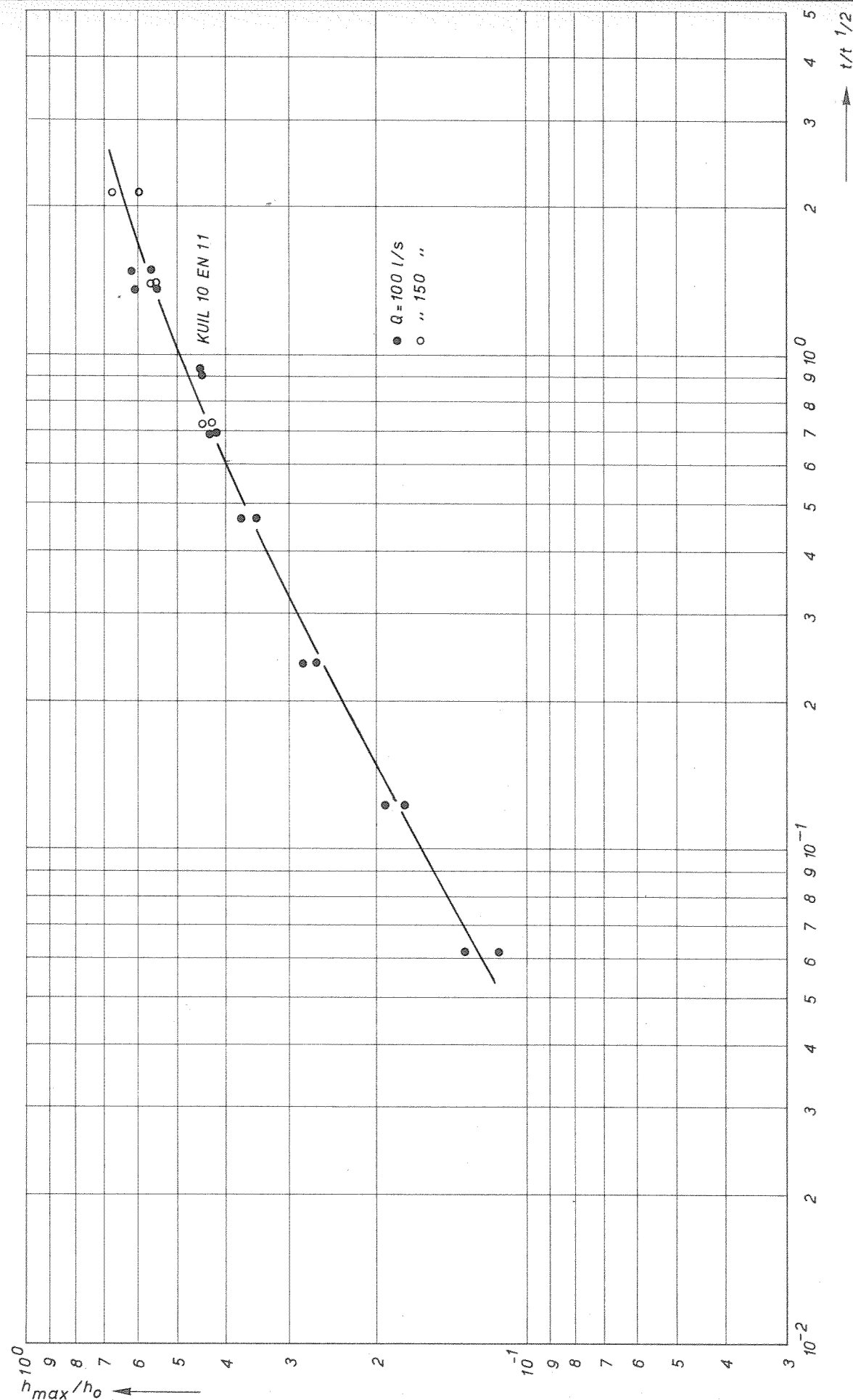
WK

A4

WATERLOOPKUNDIG LABORATORIUM

M. 1201- 1025

FIG. II-21



TJD - ONTGRONDINGSLUNEN T_{10}

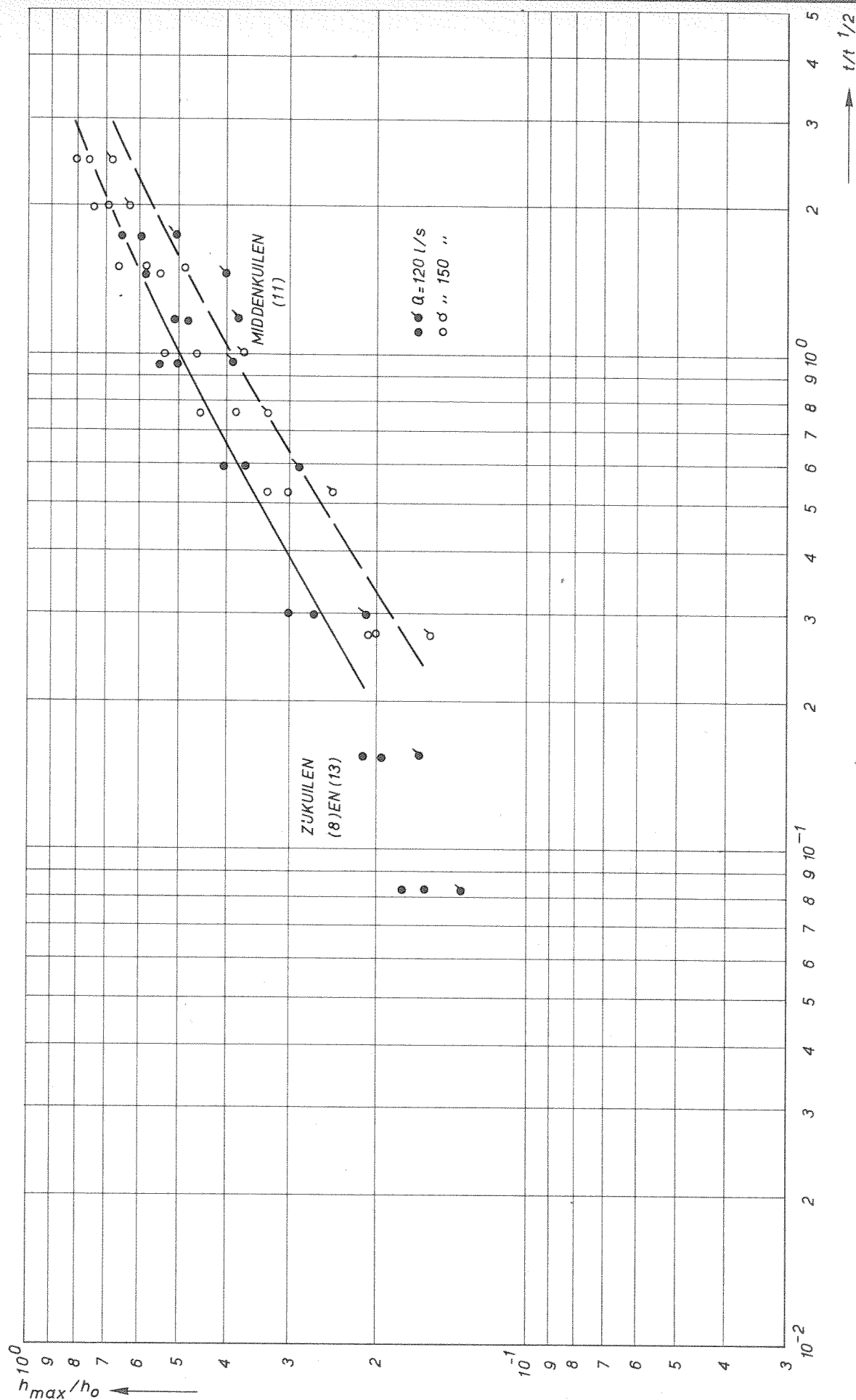
WATERLOOPKUNDIG LABORATORIUM

M. 1201- 1026

FIG. II-22

WK

A4



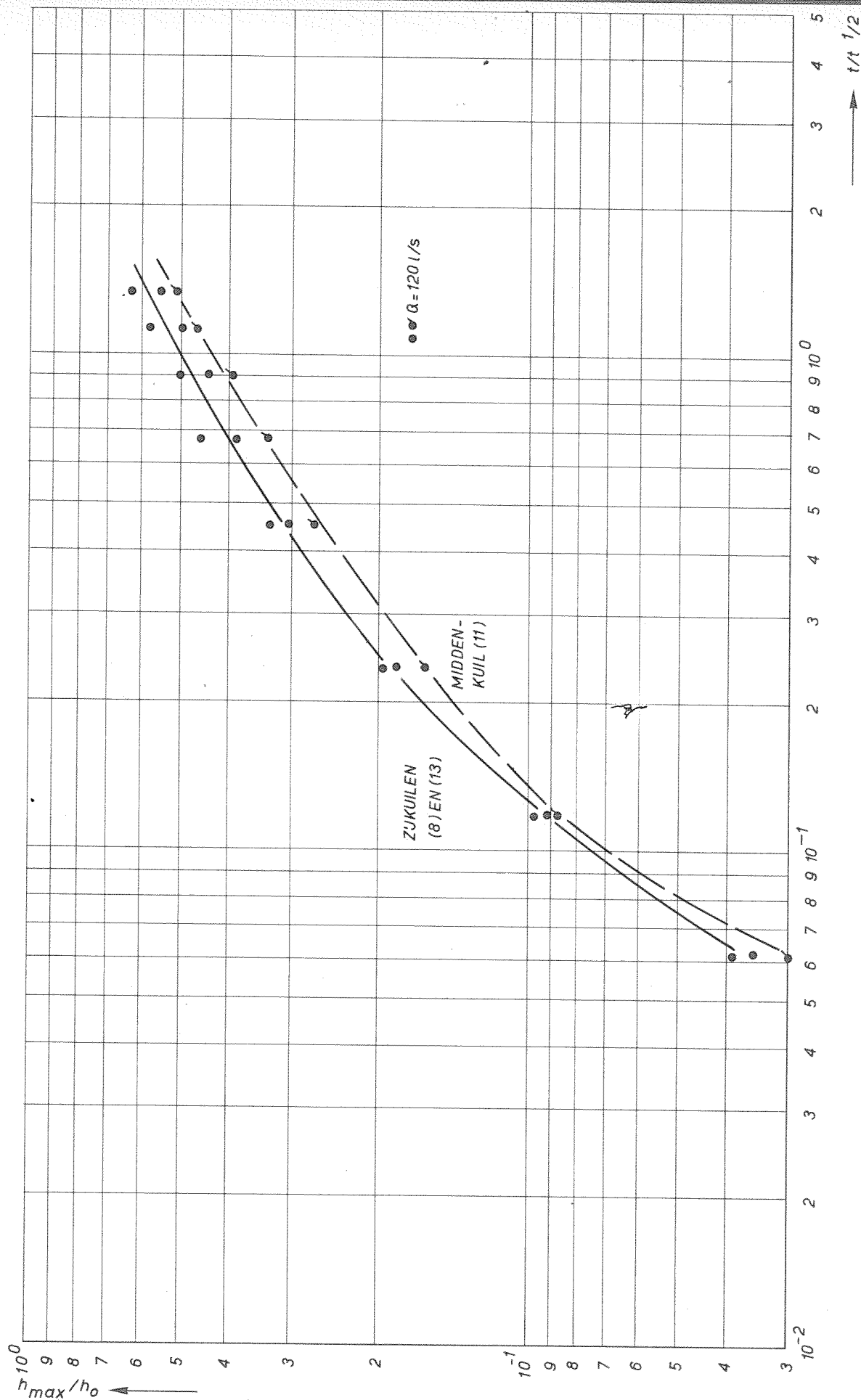
TJD - ONTGRONDINGSLIJNEN T_{11}

WK

A4

WATERLOOPKUNDIG LABORATORIUM

M. 1201-1027 FIG. II- 23



TJD - ONTGRONDINGSLIJNEN T_{12}

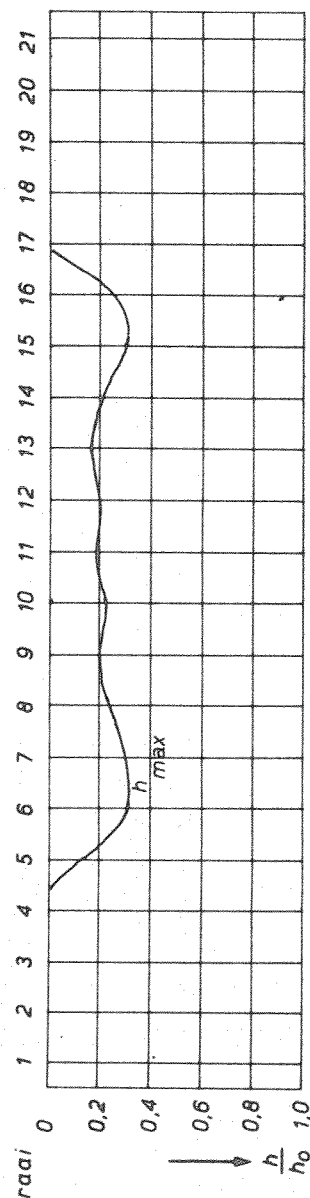
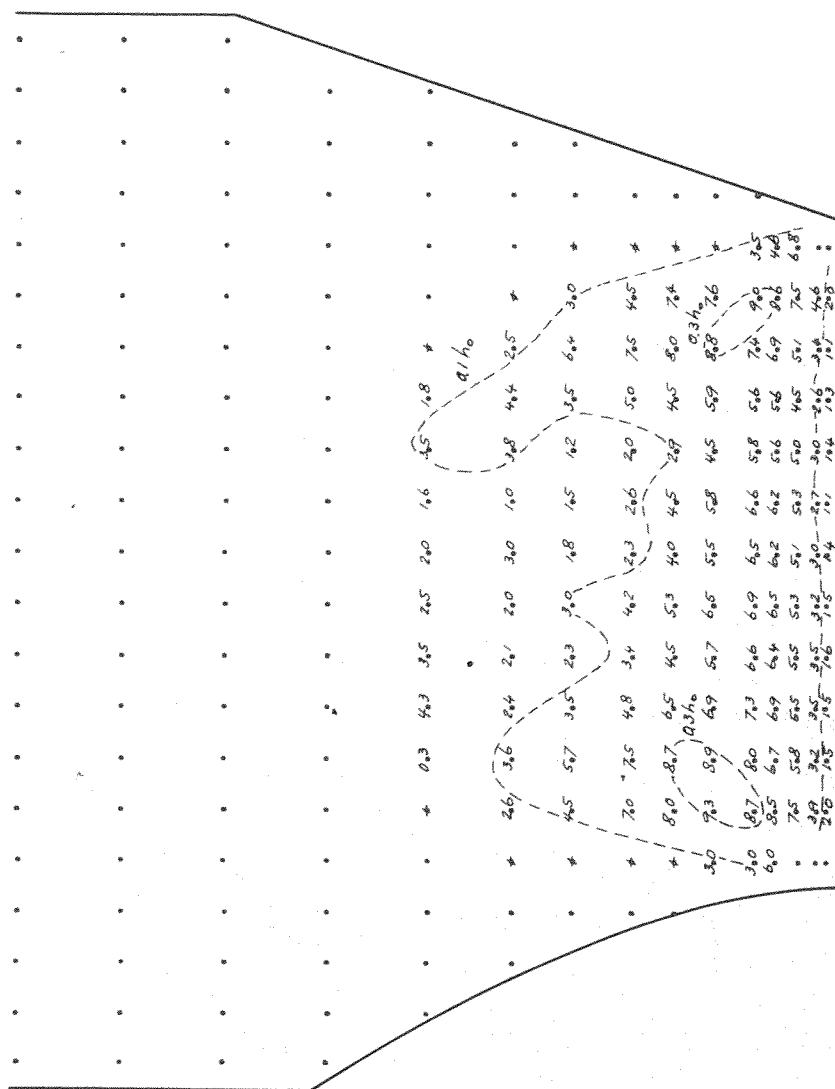
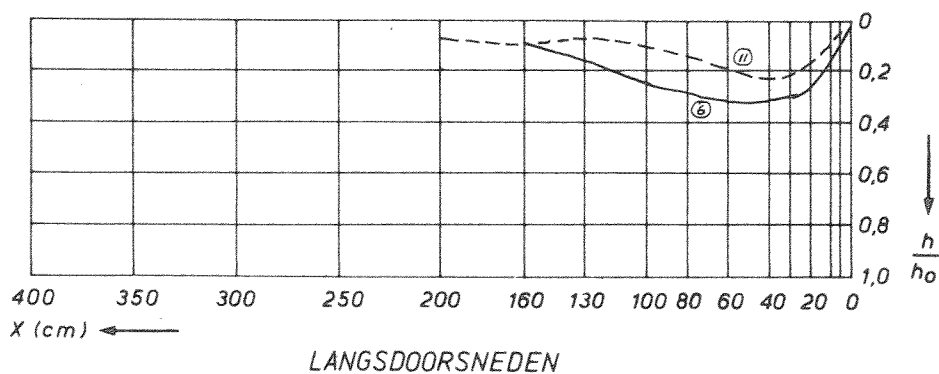
WK

A4

WATERLOOPKUNDIG LABORATORIUM

M. 1201- 1028

FIG. II-24



SITUATIE : T 1

$Q = 102 \text{ l/s}$

$t = 13.00 - 13.10$

$t/t^{1/2} = 0.4$

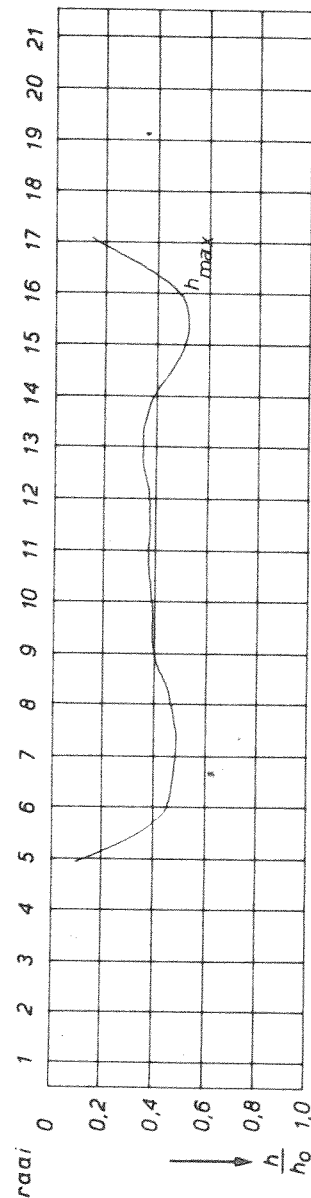
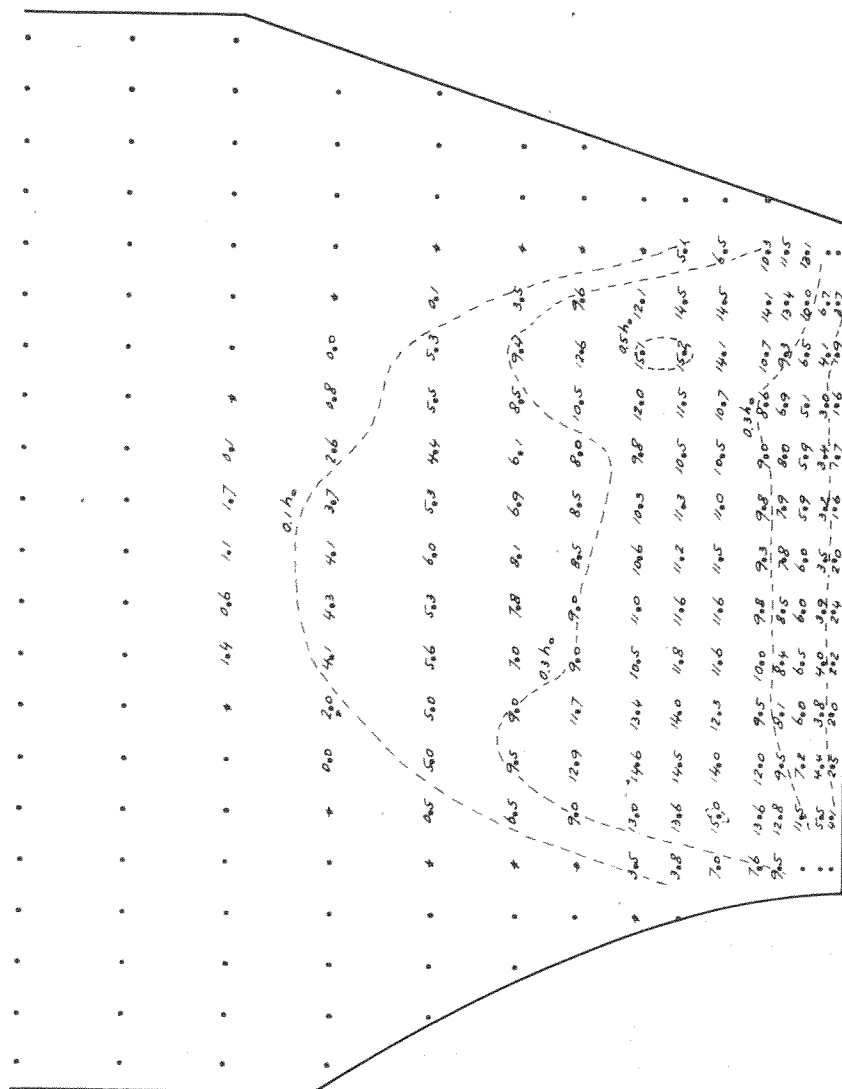
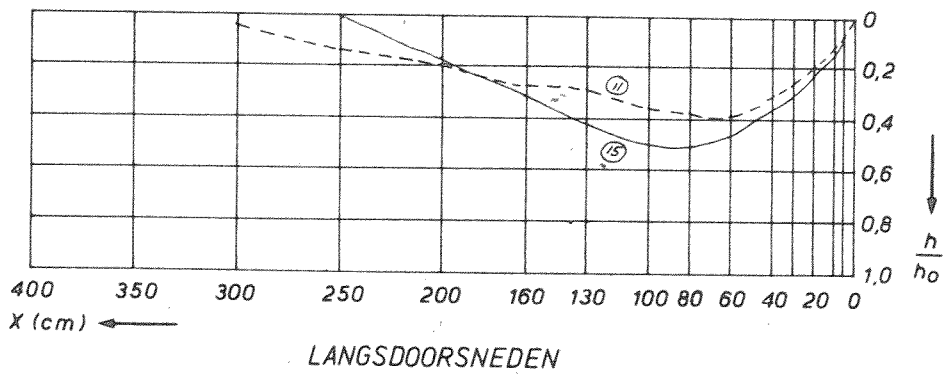
$h_0 = 28.6 \text{ cm}$

R.R.

WATERLOOPKUNDIG LABORATORIUM

M.1201 - 1066

FIG.II-25



SITUATIE : T 1

$Q = 152 \text{ l/s}$

$t = 2.30 - 2.45$

$t/t_{1/2} = 1.0$

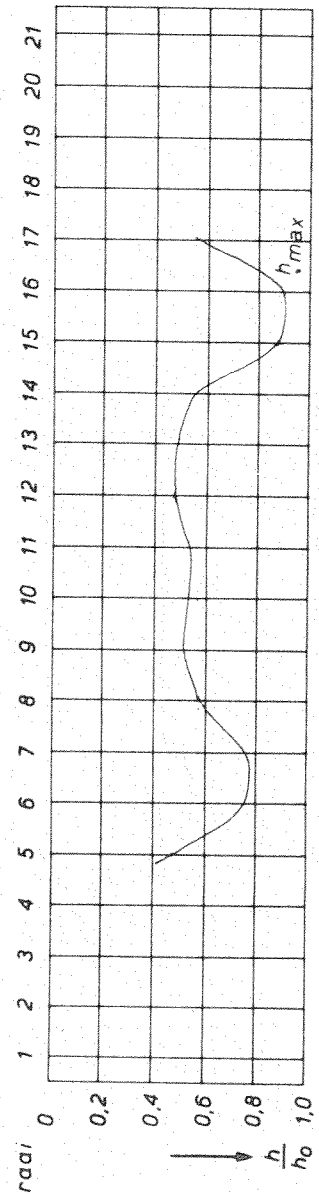
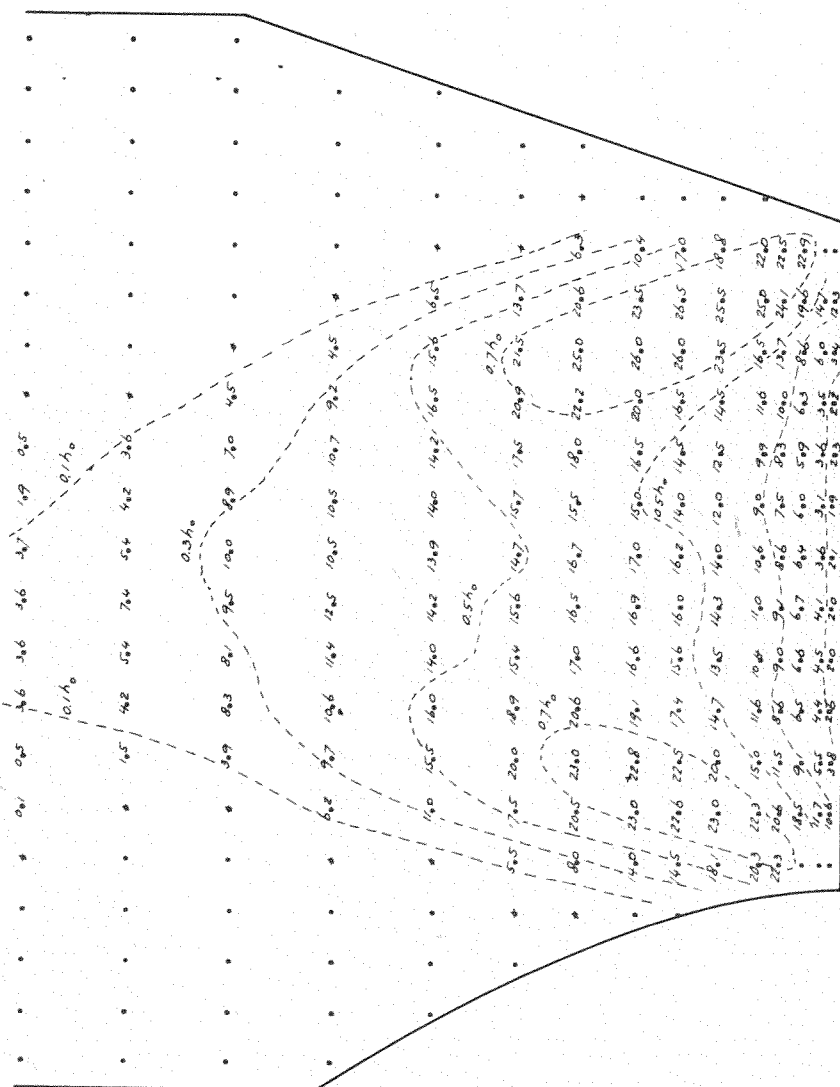
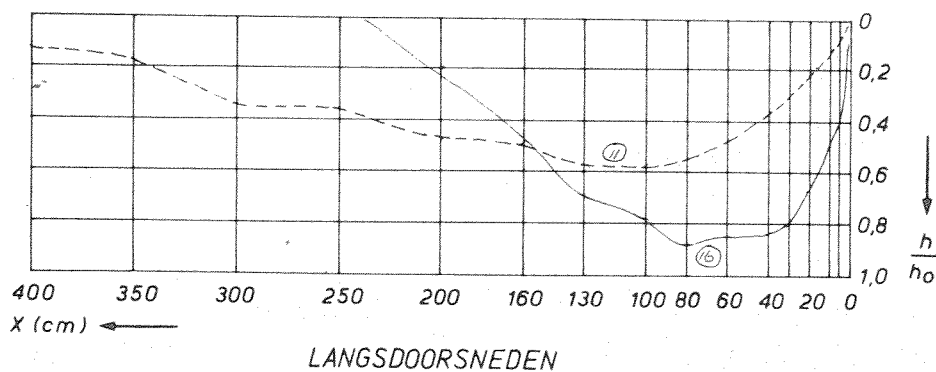
$h_0 = 29.9 \text{ cm}$

R.R.

WATERLOOPKUNDIG LABORATORIUM

M.1201 - 1067

FIG. II-26



SITUATIE : T 1

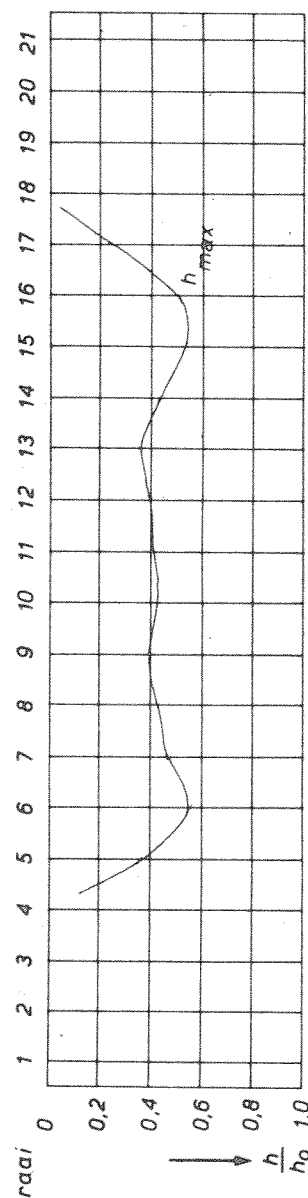
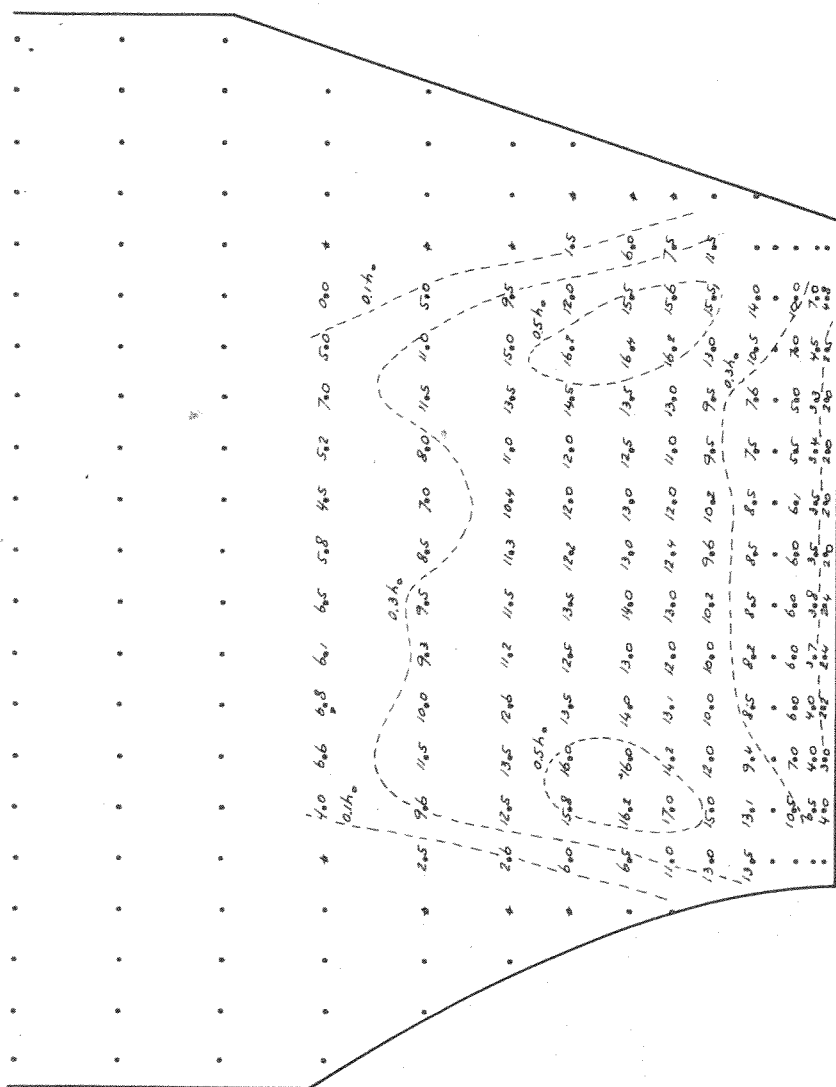
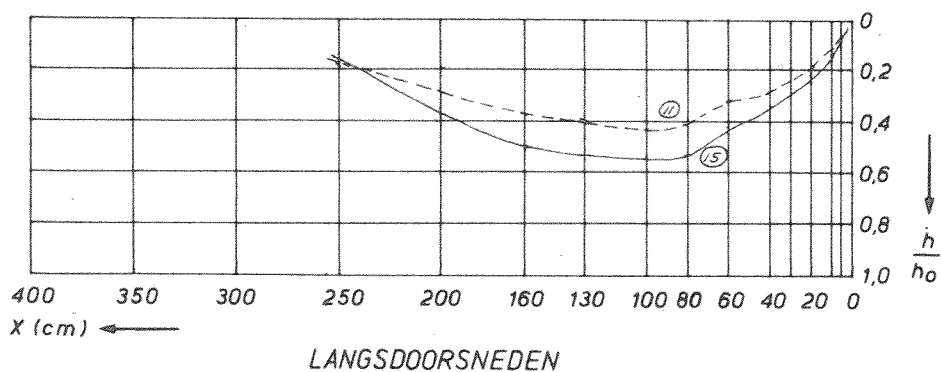
$Q = 152 \text{ l/s}$

$t = 6.30 - 6.50$

$t/t_{1/2} = 2.57$

$h_0 = 29.9 \text{ cm}$

R.R.



SITUATIE : T 1

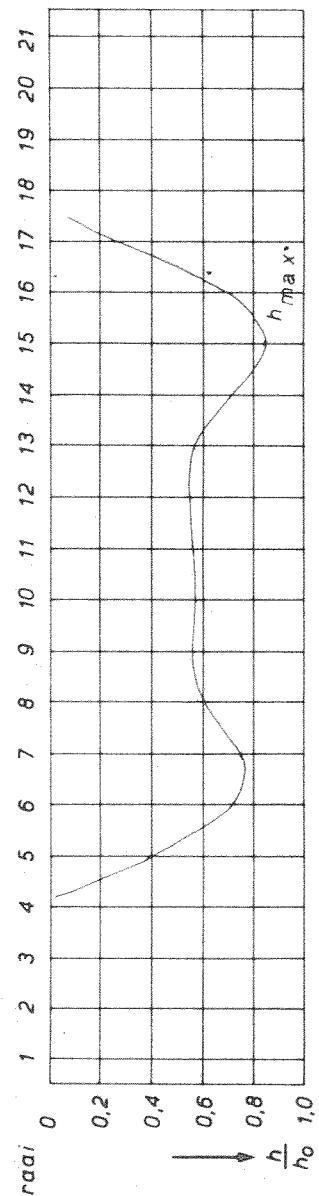
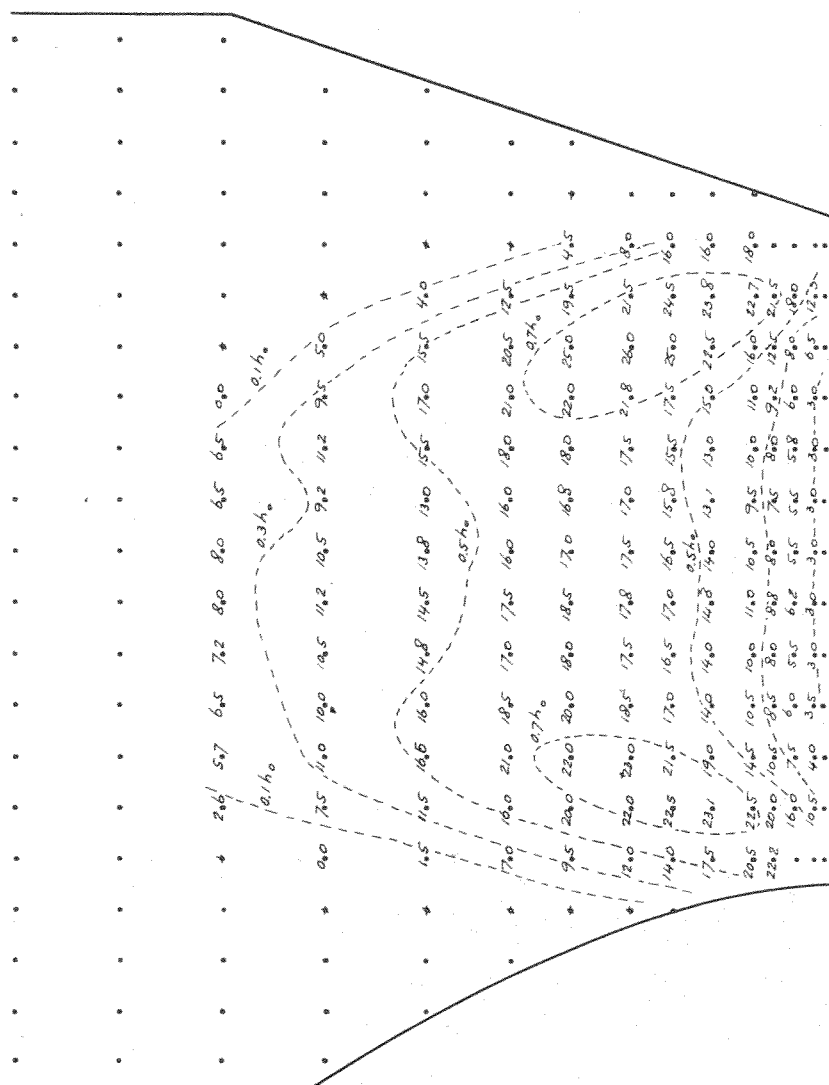
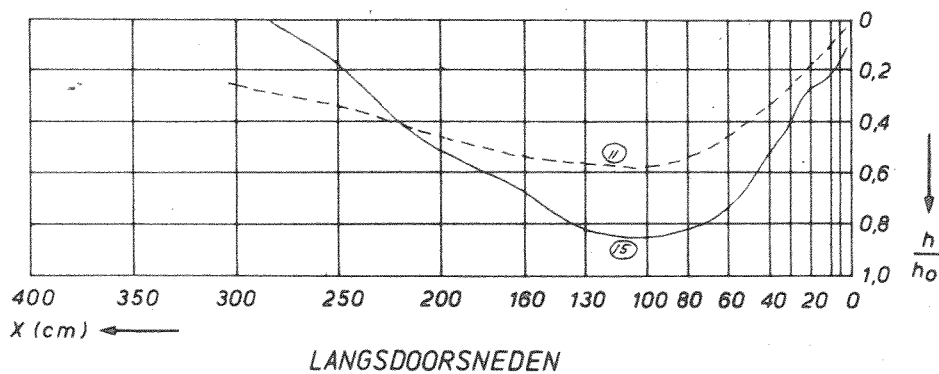
$Q = 203 \text{ l/s}$

$t = 0.33 - 0.41$

$t/t_{1/2} = 1.26$

$h_0 = 30.4 \text{ cm}$

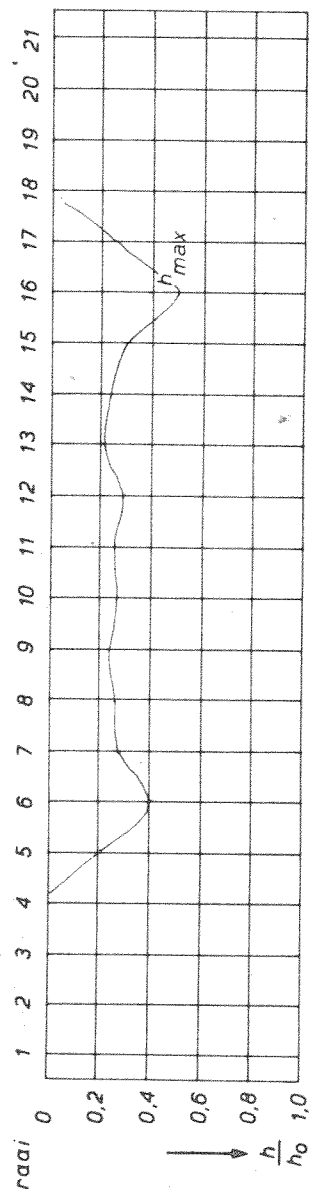
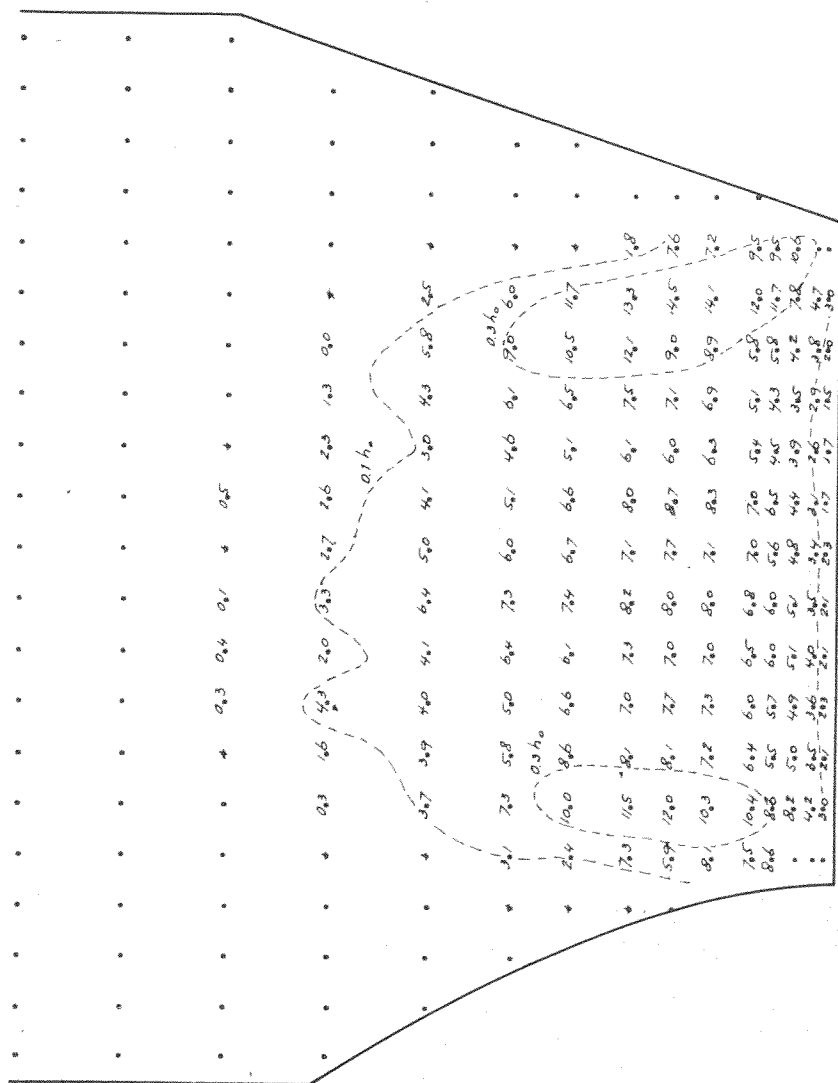
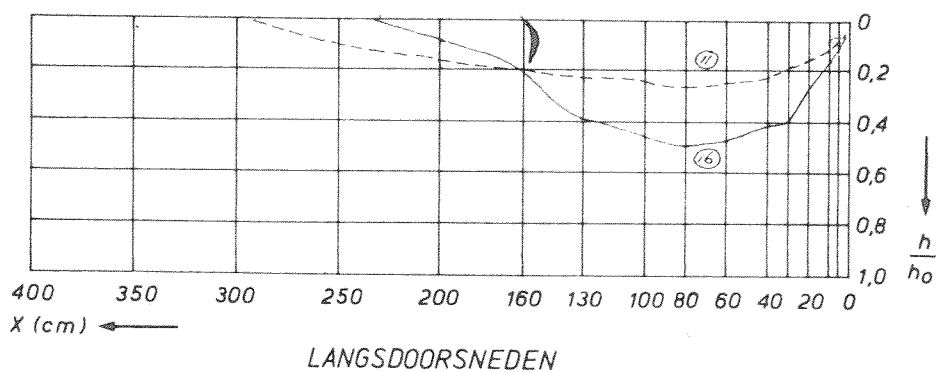
R.R.



SITUATIE : T₁
 $Q = 203 \text{ l/s}$
 $t = 1.00 - 1.30$

$t/t_{1/2} = 2.25$
 $h_0 = 30.4 \text{ cm}$

R.R.



SITUATIE : T 2

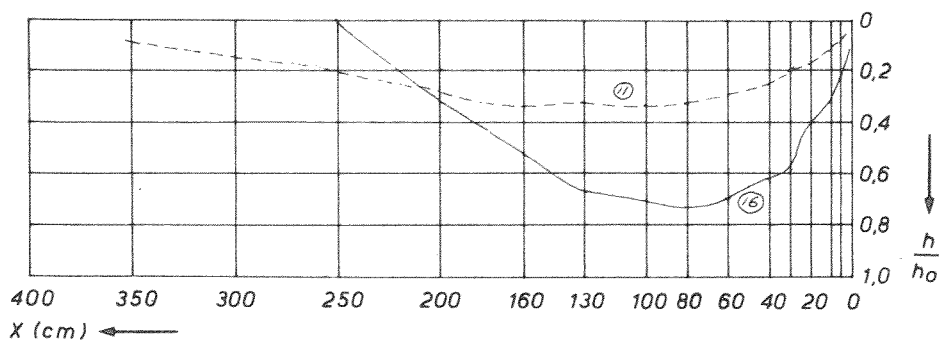
$Q = 152 \text{ l/s}$

$t = 2.30 - 2.44$

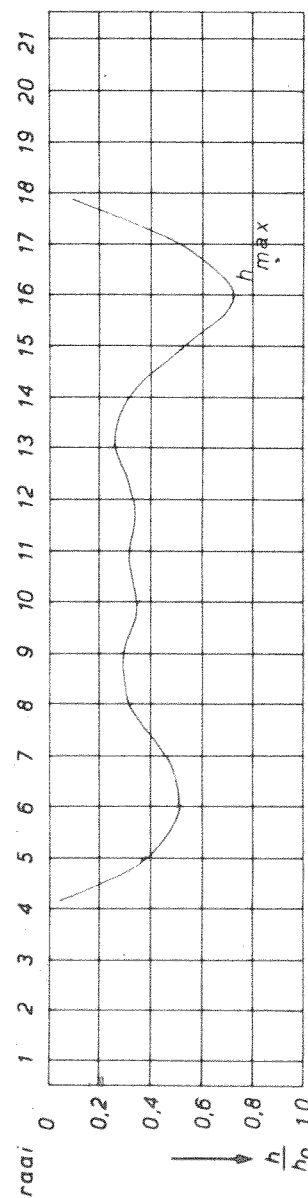
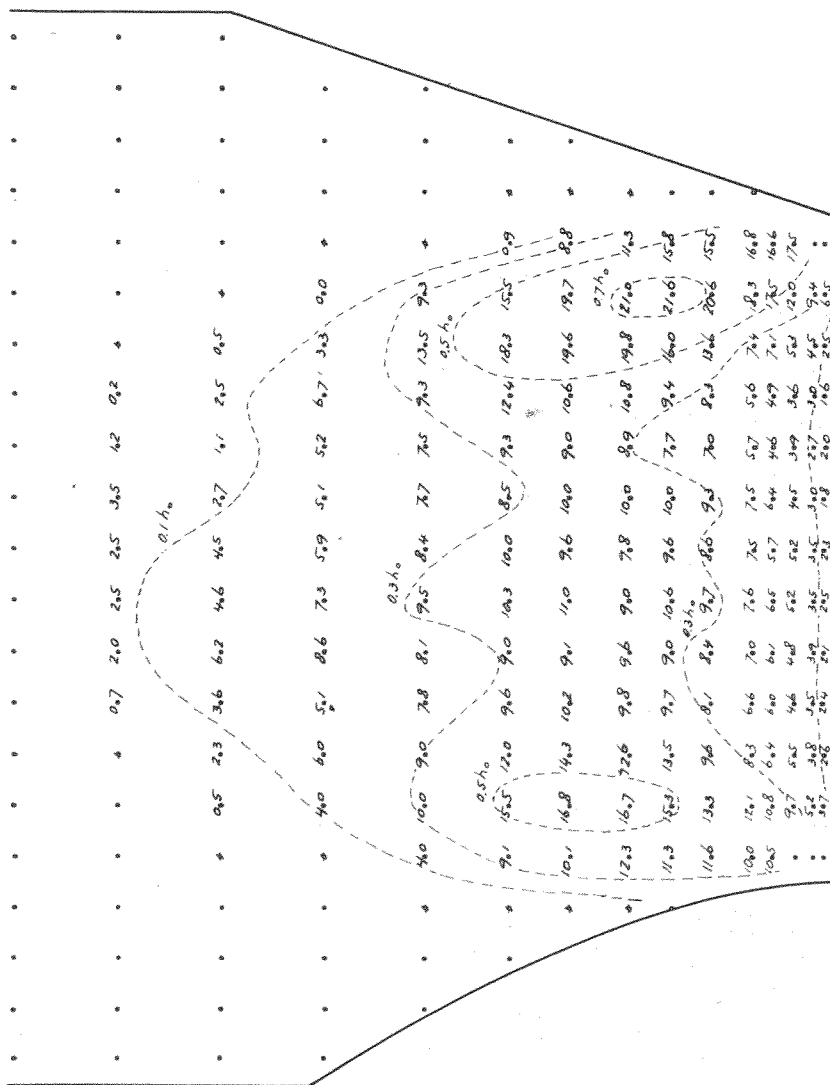
$t/t^{1/2} = 0.82$

$h_0 = 29.6 \text{ cm}$

R.R.



LANGSDOORSNEDEN



DWARSDOORSNEDEN

SITUATIE : T 2

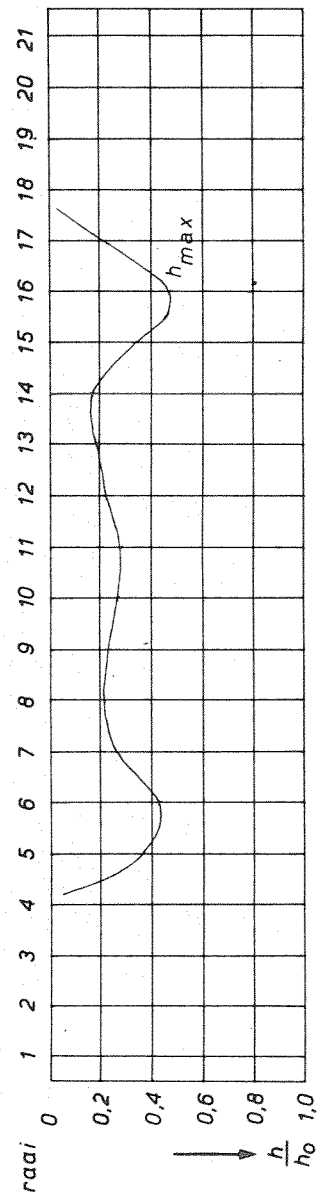
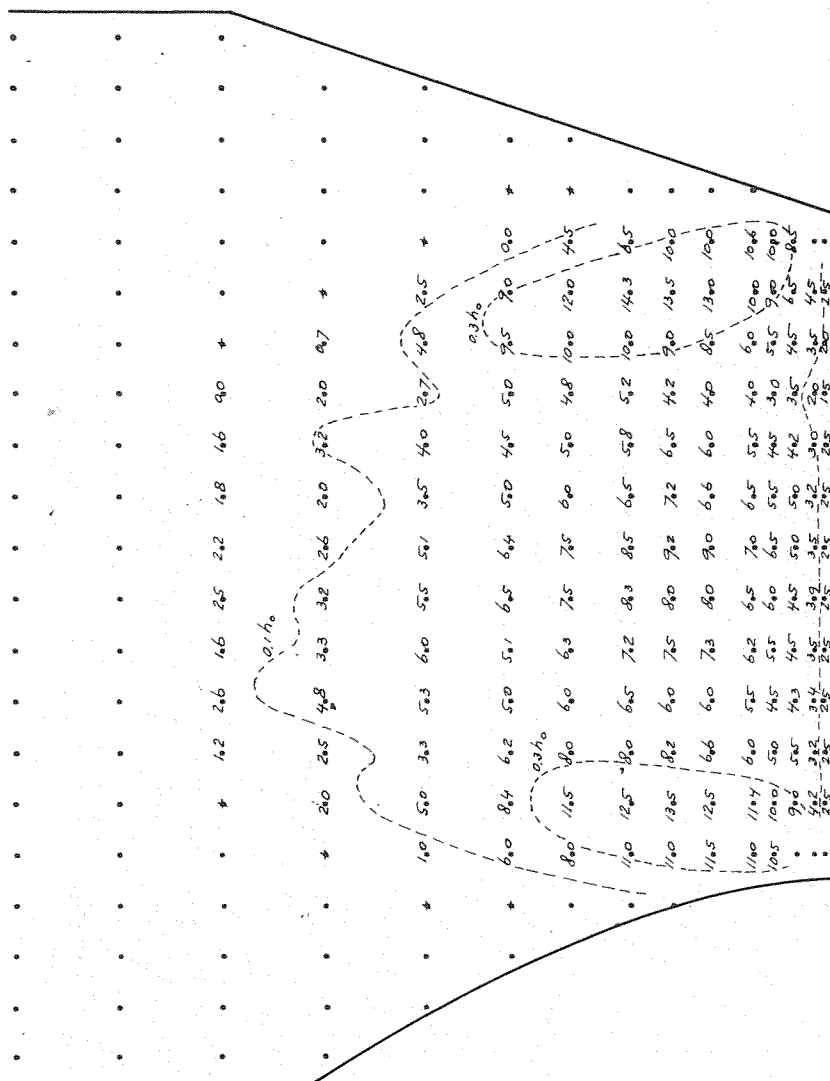
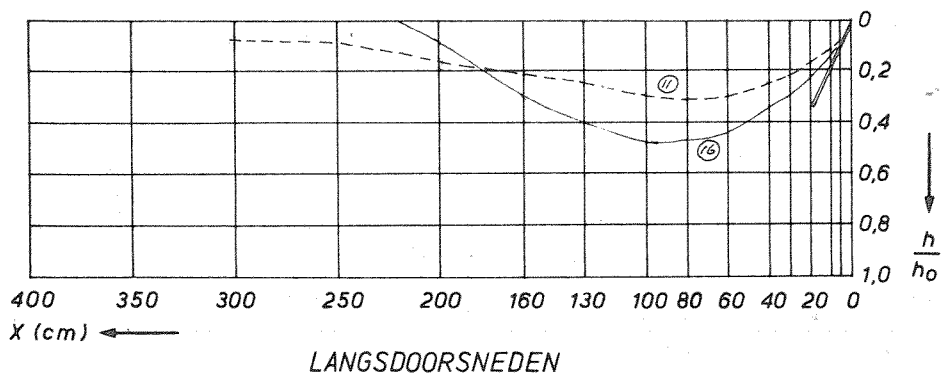
$Q = 152 \text{ l/s}$

$t = 4.30 - 4.50$

$t/t_{1/2} = 1.46$

$h_0 = 29.6 \text{ cm}$

R.R.



SITUATIE : T 3

$Q = 152 \text{ l/s}$

$t = 3.00 - 3.15$

$t/t^{1/2} = 0.93$

$h_0 = 29.6 \text{ cm}$

R.R.

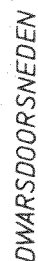
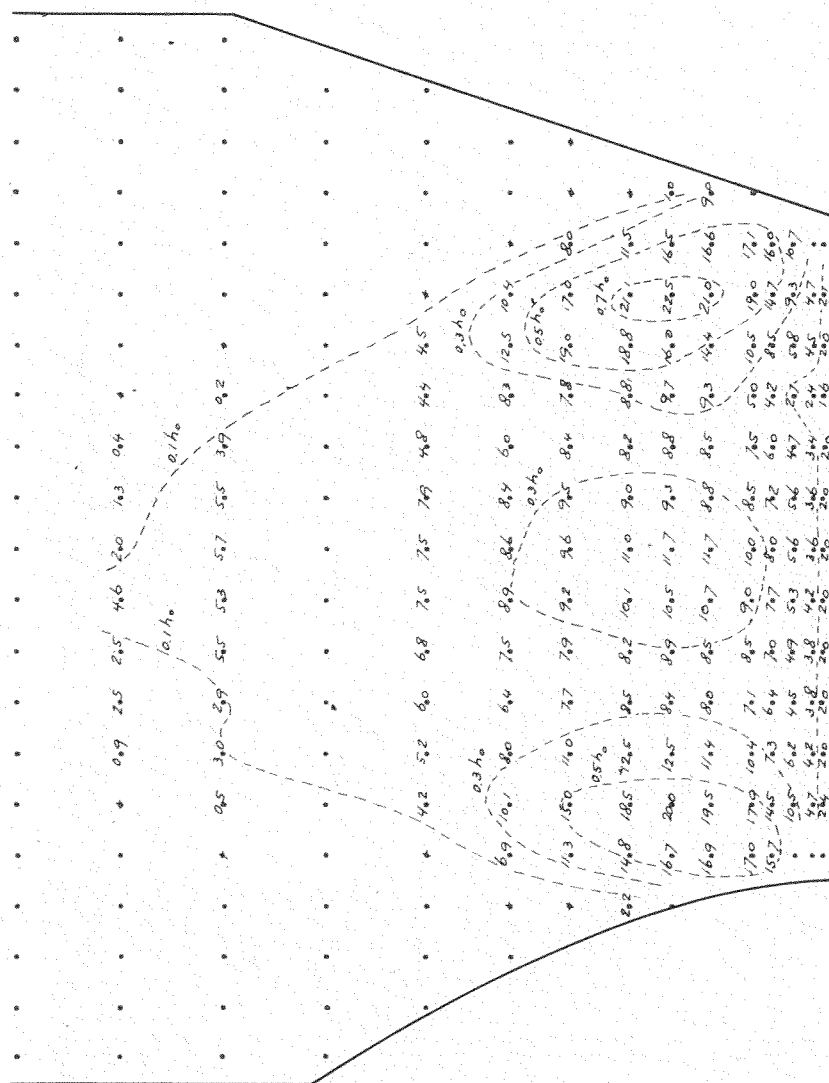
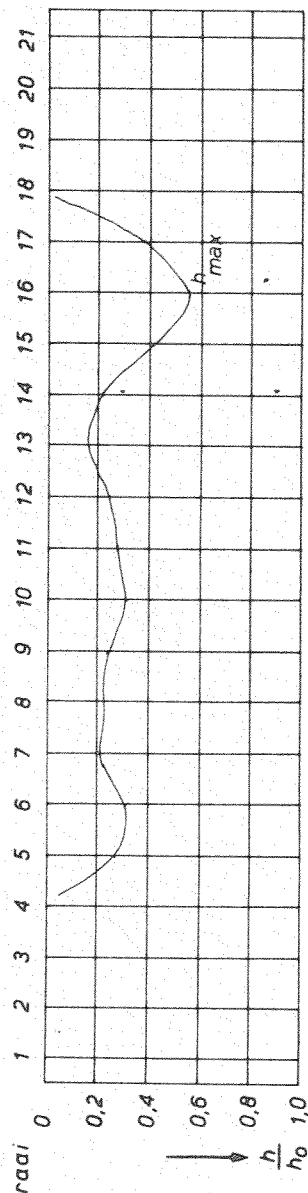
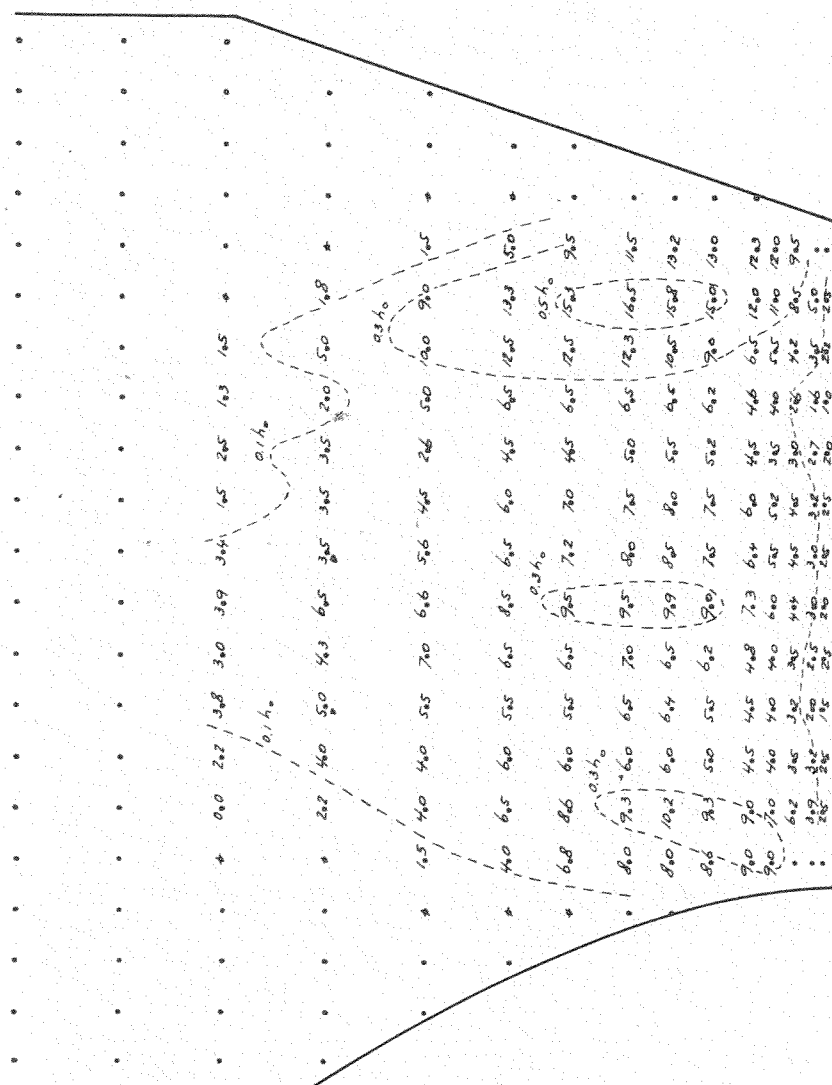
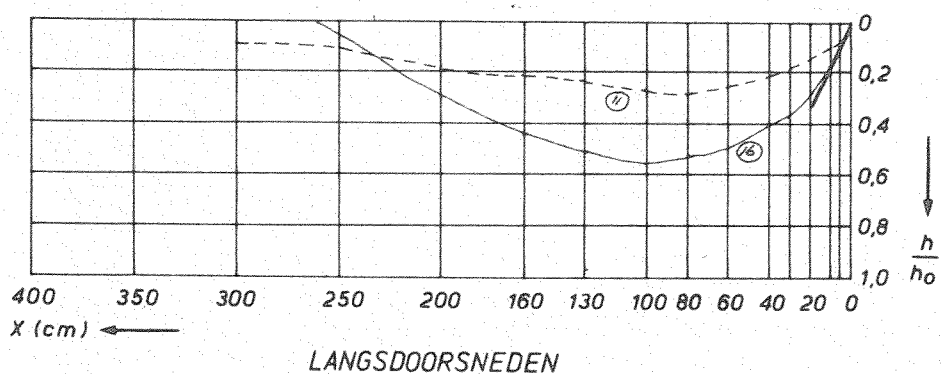


FIG. II-33



SITUATIE T 4

$Q = 152 \text{ l/s}$

$t = 4.00 - 4.25$

$t/t_{1/2} = 1.17$

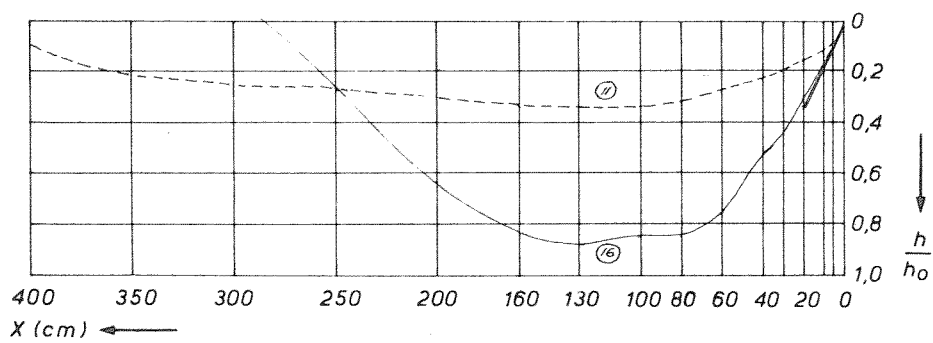
$h_0 = 29.6 \text{ cm}$

R.R.

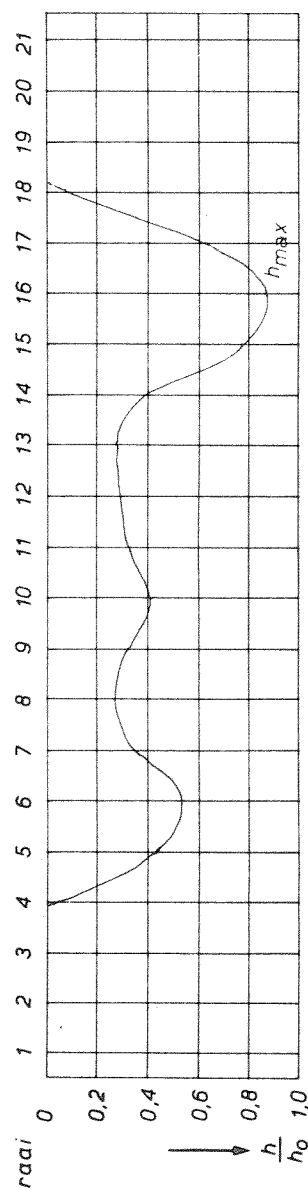
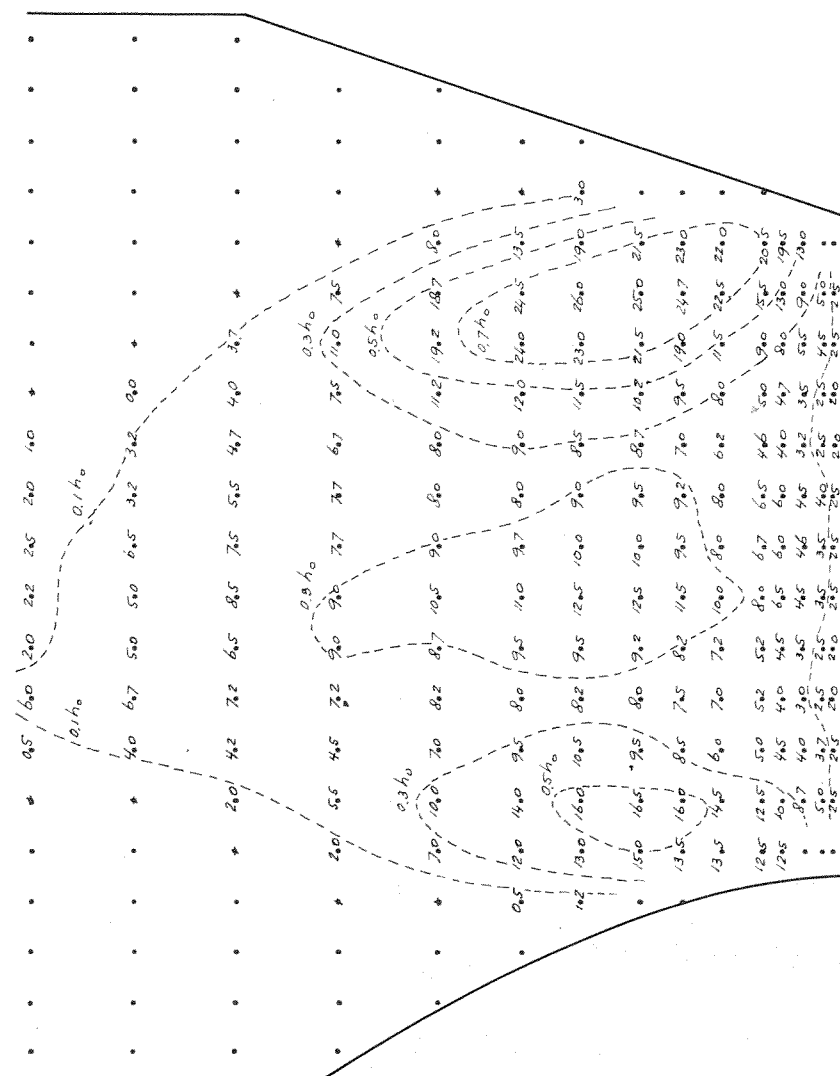
WATERLOOPKUNDIG LABORATORIUM

M.1201 - 1075

FIGII-34



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SITUATIE : T 4

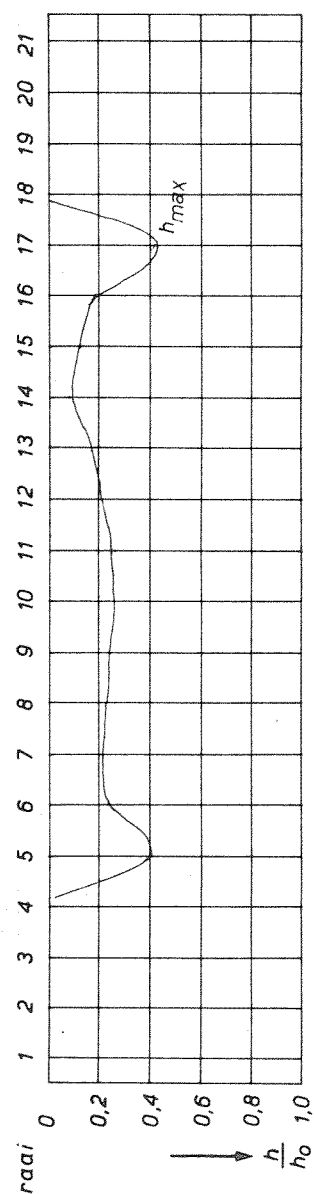
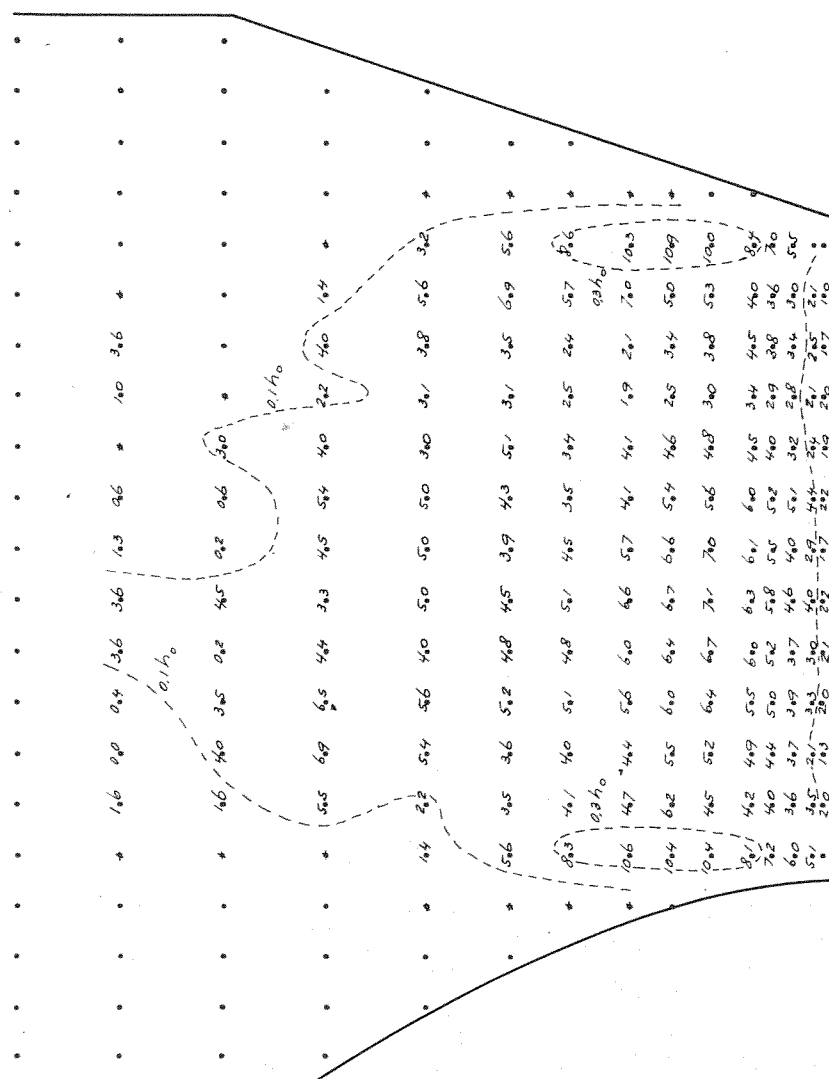
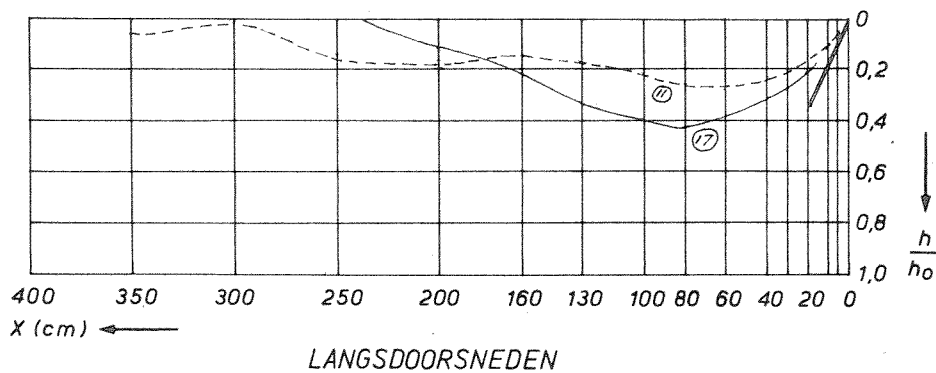
$Q = 152 \text{ l/s}$

$t = 7.00 - 7.15$

$t/t_{1/2} = 1.98$

$h_0 = 29.6 \text{ cm}$

RR



SITUATIE : T 5

$Q = 102 \text{ l/s}$

$t = 19.00 - 19.18$

$t/t_{1/2} = 0.76$

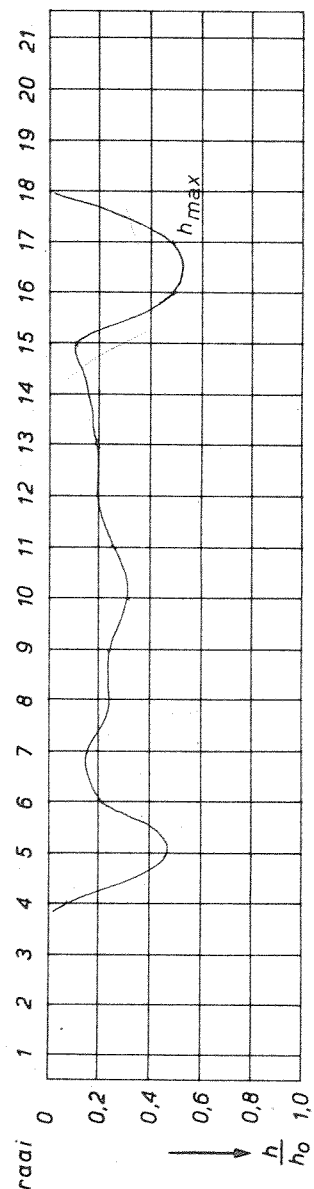
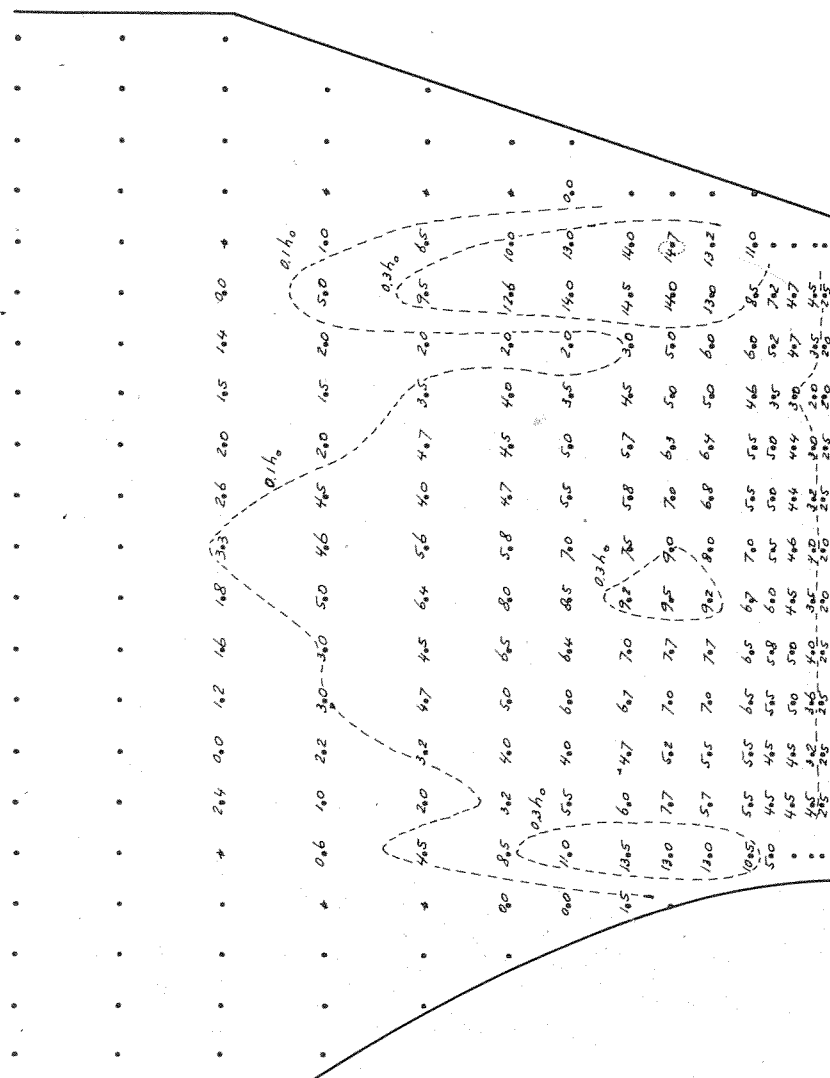
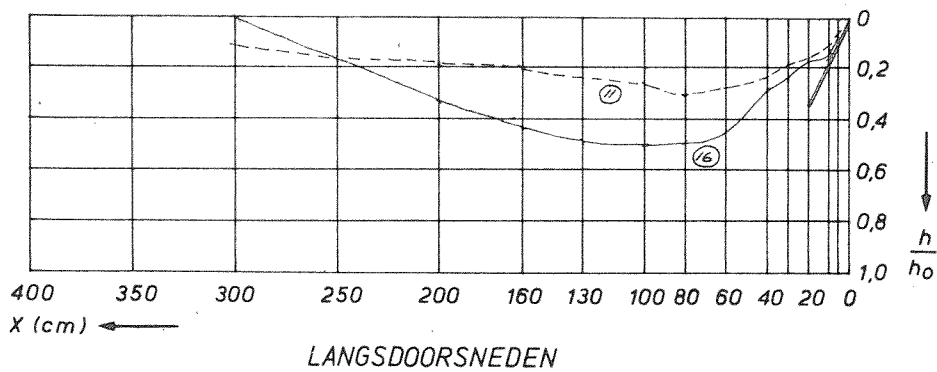
$h_0 = 26.0 \text{ cm}$

R.R.

WATERLOOPKUNDIG LABORATORIUM

M.1201 - 1077

FIG.II-36



SITUATIE : T 5

$Q = 152 \text{ l/s}$

$t = 5.00 - 5.25$

$t/t_{1/2} = 0.96$

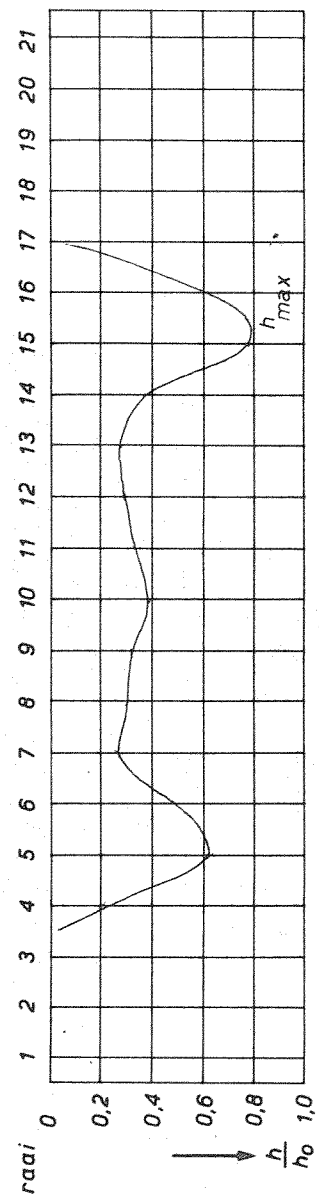
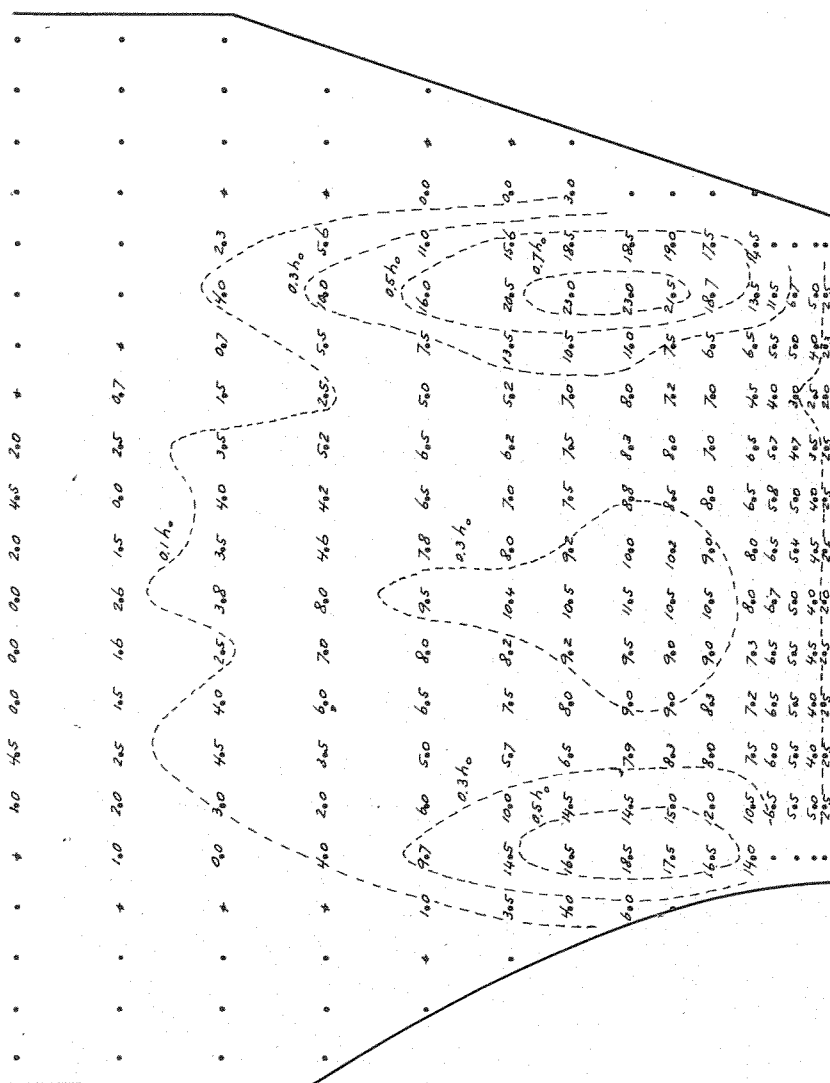
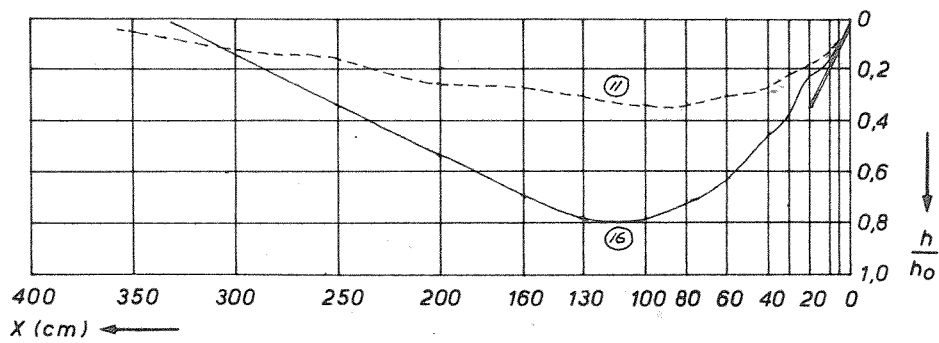
$h_0 = 29.7 \text{ cm}$

R.R.

WATERLOOPKUNDIG LABORATORIUM

M.1201 - 1078

FIG.II-37



SITUATIE : T 5

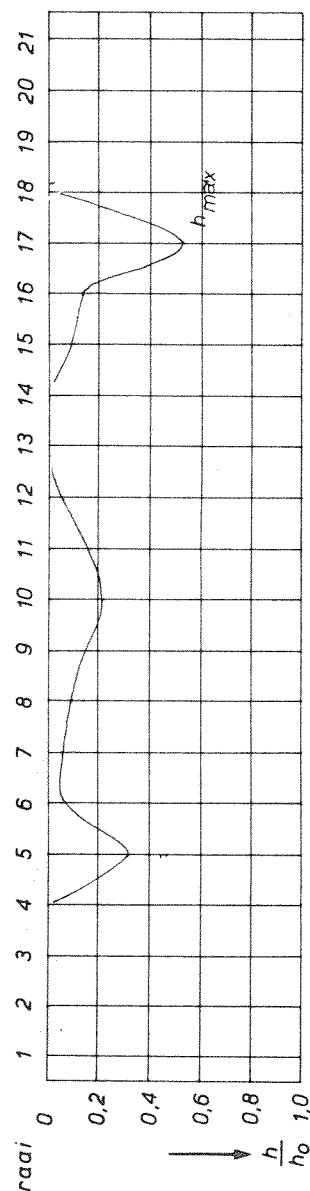
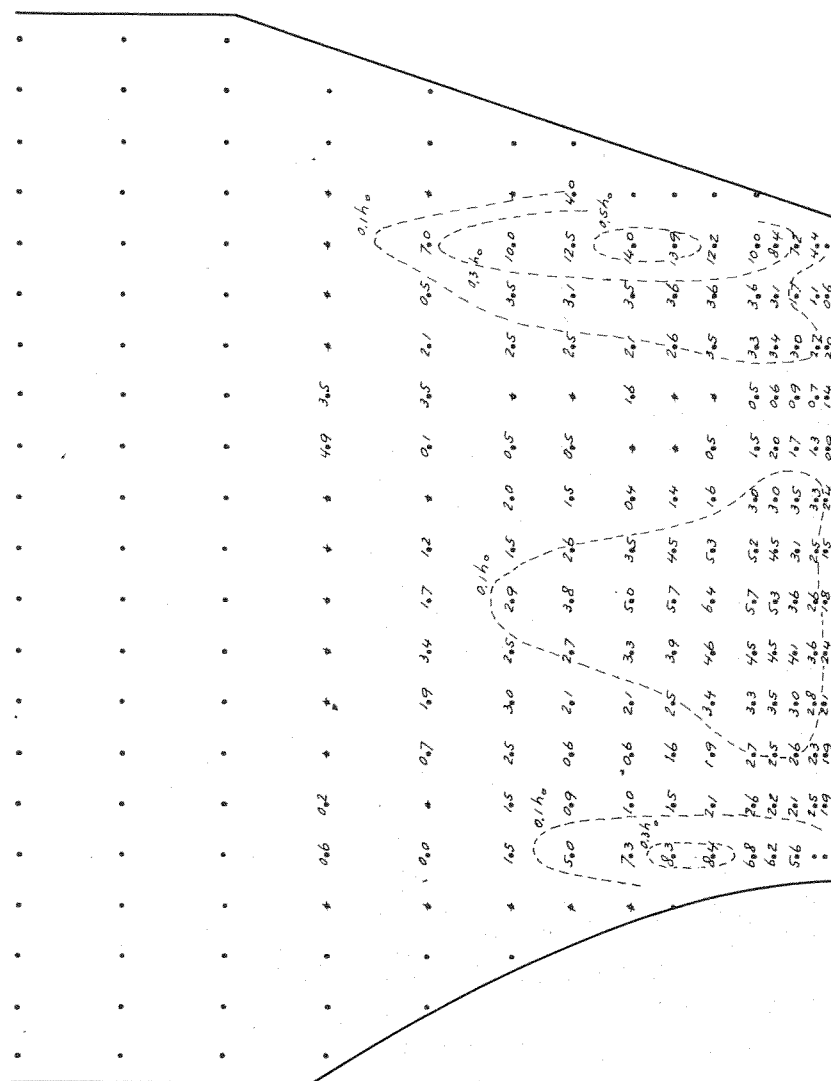
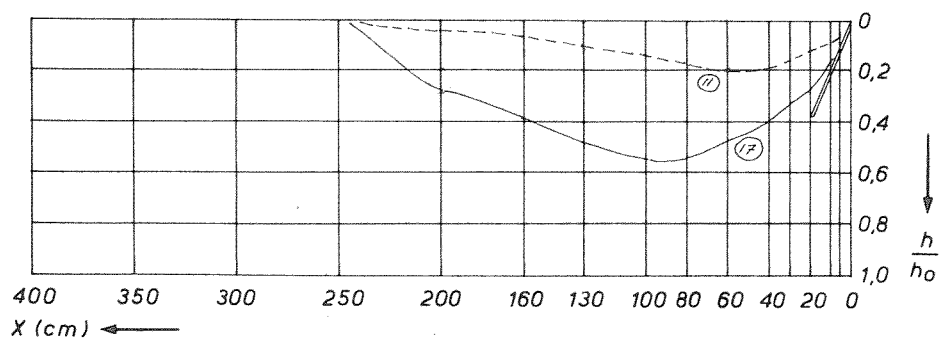
$Q = 152 \text{ l/s}$

$t = 8.00 - 8.25$

$t/t_{1/2} = 1.52$

$h_0 = 29.7 \text{ cm}$

R.R.



SITUATIE : T 5^A

$Q = 102 \text{ l/s}$

$t = 11.00 - 11.13$

$t/t^{1/2} = 1.29$

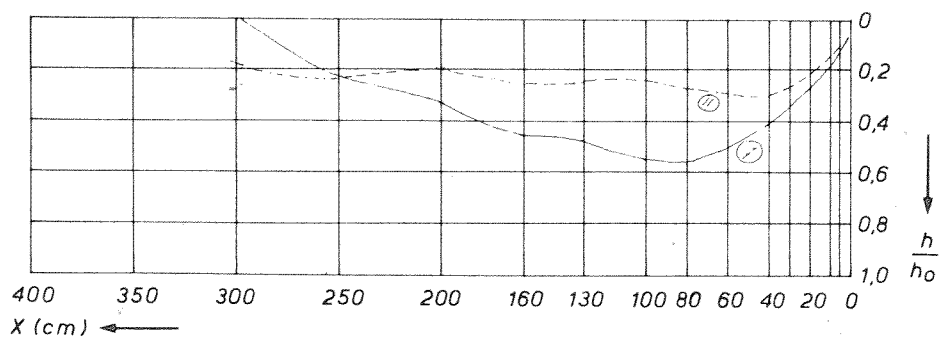
$h_0 = 25.8 \text{ cm}$

R.R.

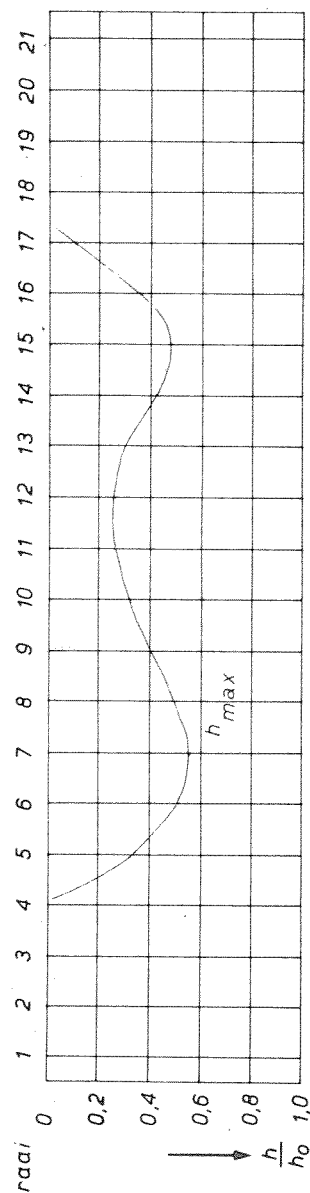
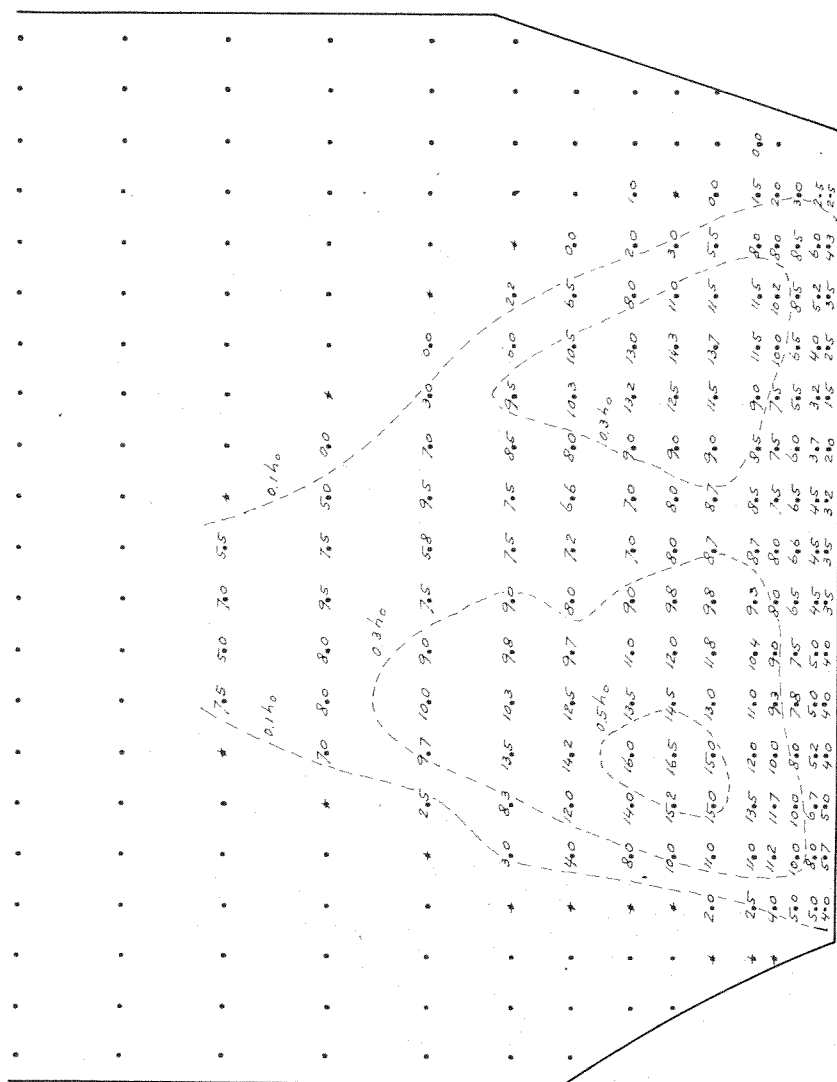
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FIG.II-39



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SITUATIE : T 6

$Q = 122 \text{ l/s}$

$t = 8.00 - 8.20$

$t/t_{1/2} = 0.95'$

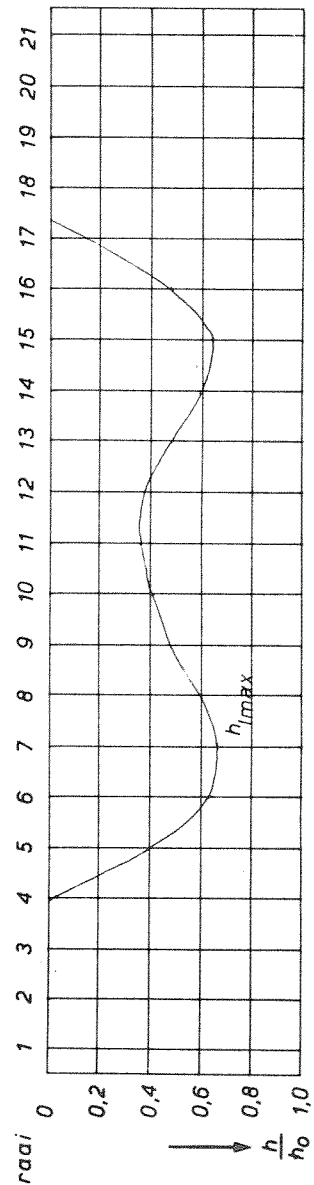
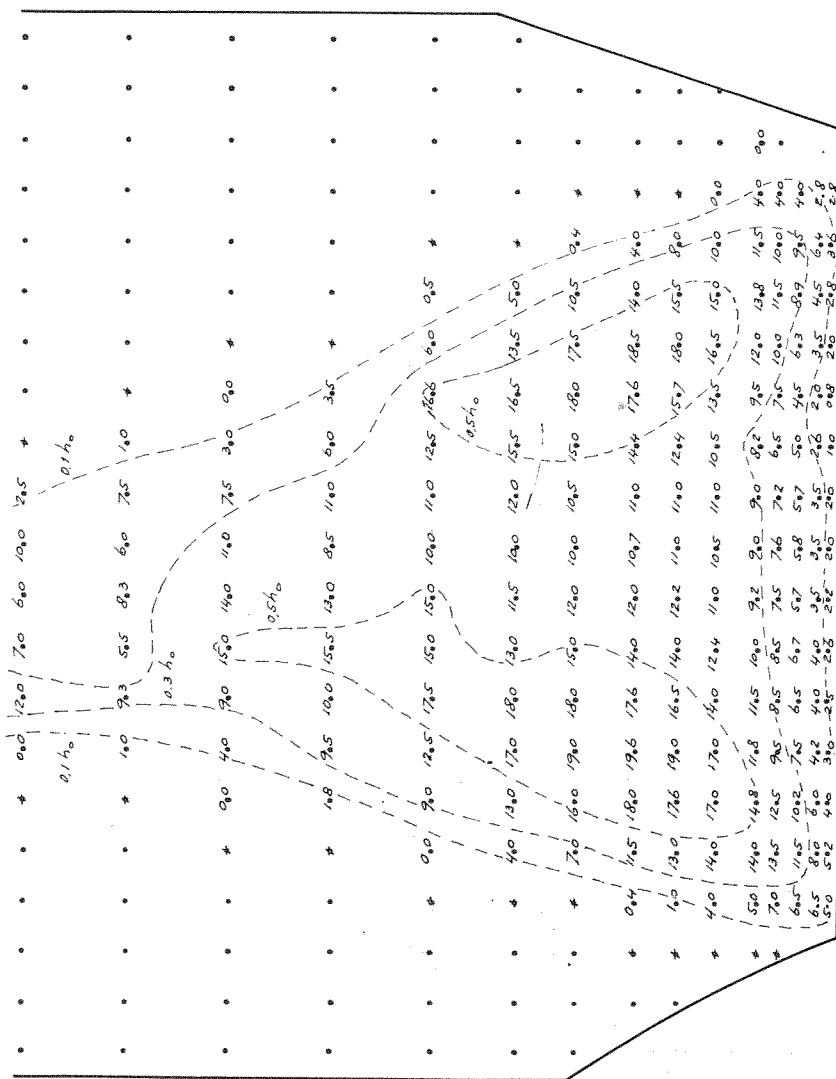
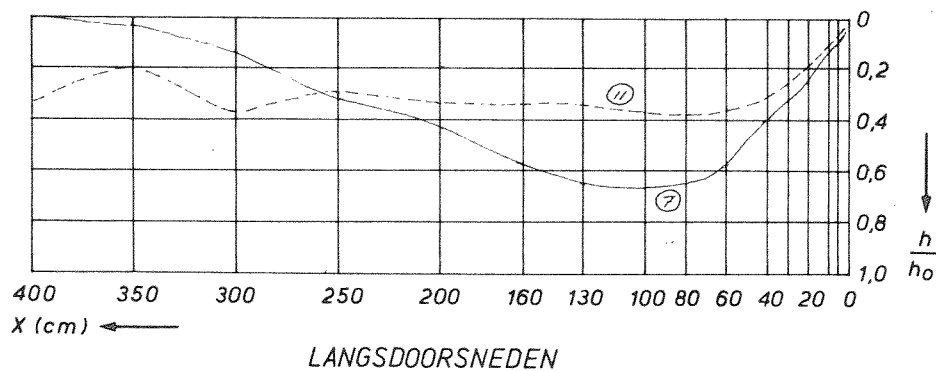
$h_0 = 29.2 \text{ cm}$

R.R.

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FIG.II-40



SITUATIE : T 6

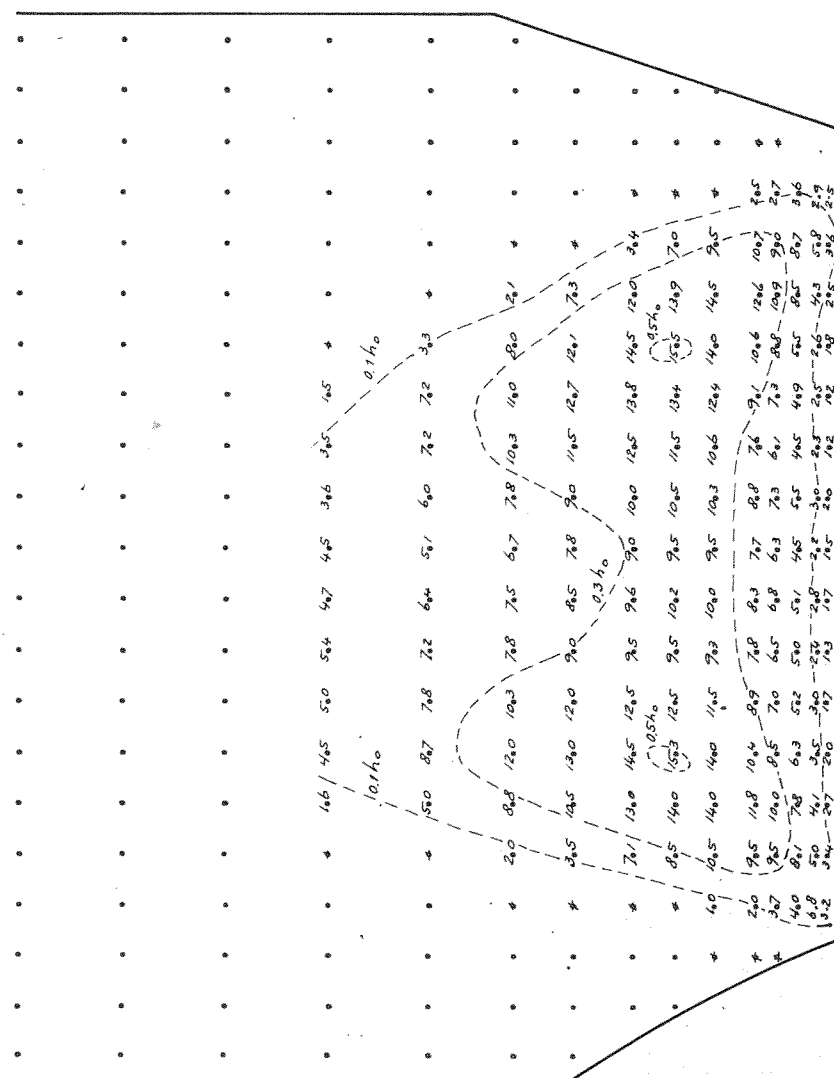
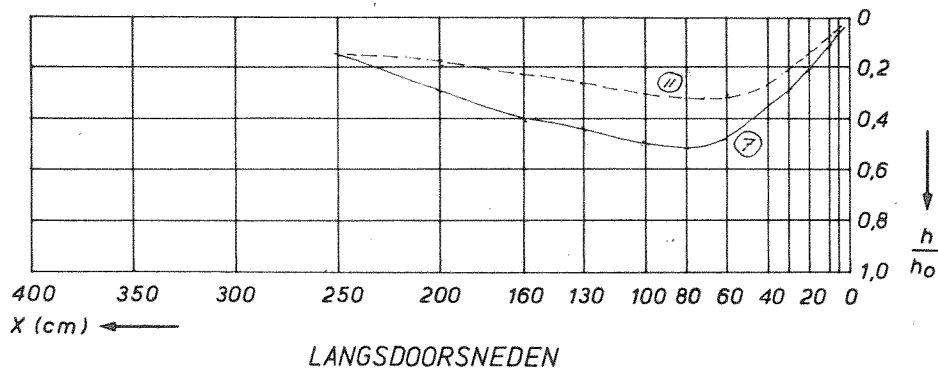
$Q = 122 \text{ l/s}$

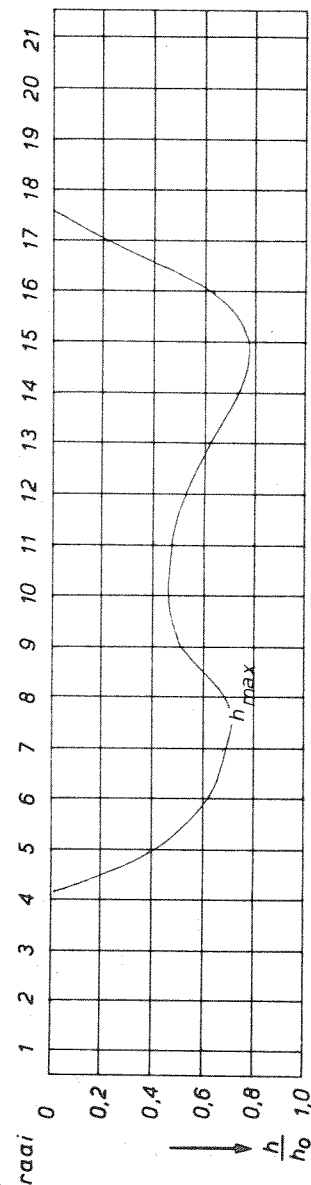
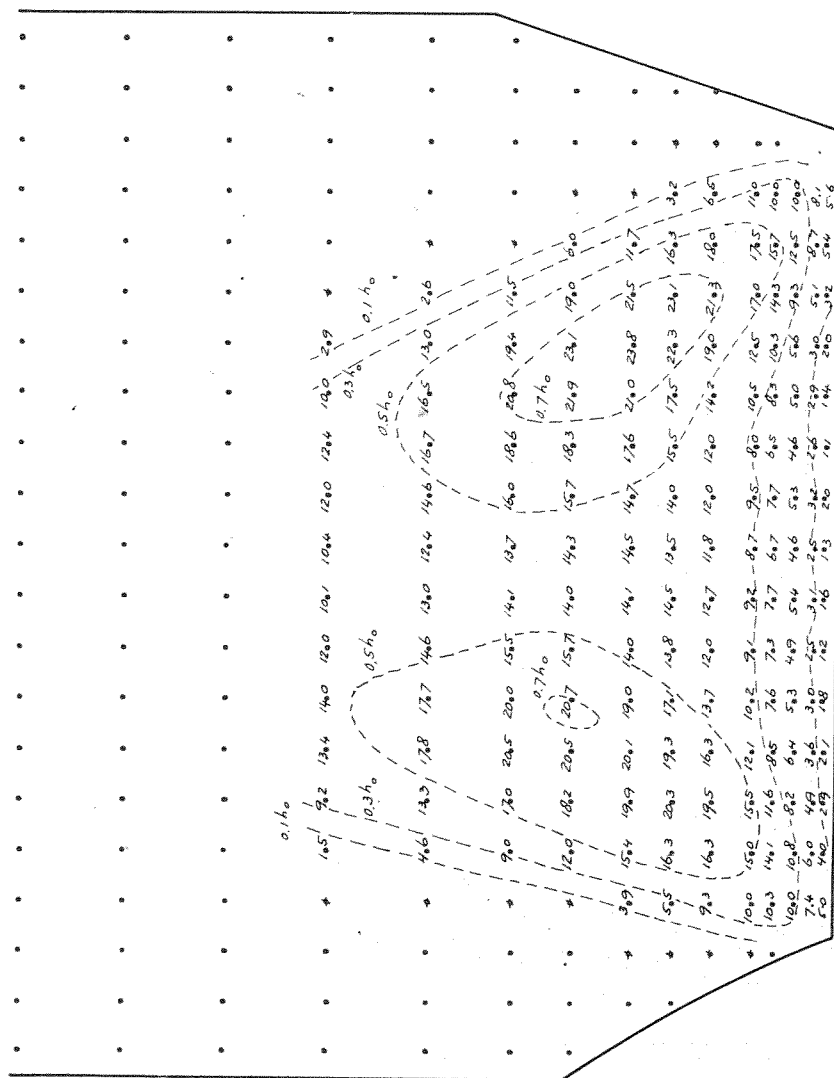
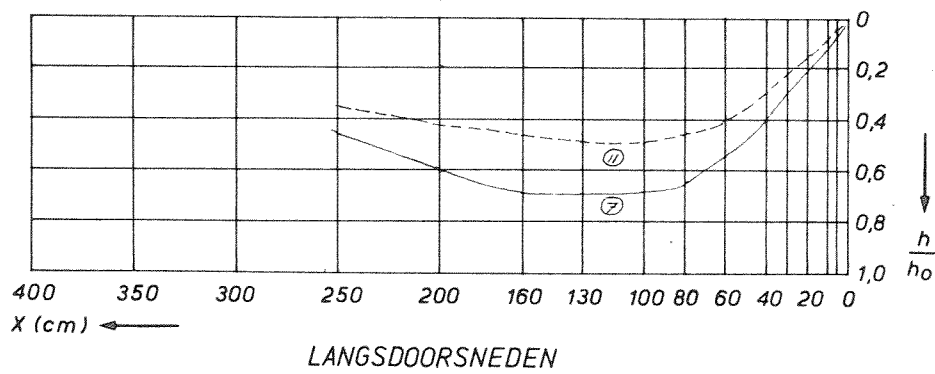
$t = 16.00 - 16.20$

$t/t_{1/2} = 1.88$

$h_0 = 29.2 \text{ cm}$

R.R.





SITUATIE : T 6

$Q = 152 \text{ l/s}$

$t = 7.00 - 7.25$

$t/t^{1/2} = 2.4$

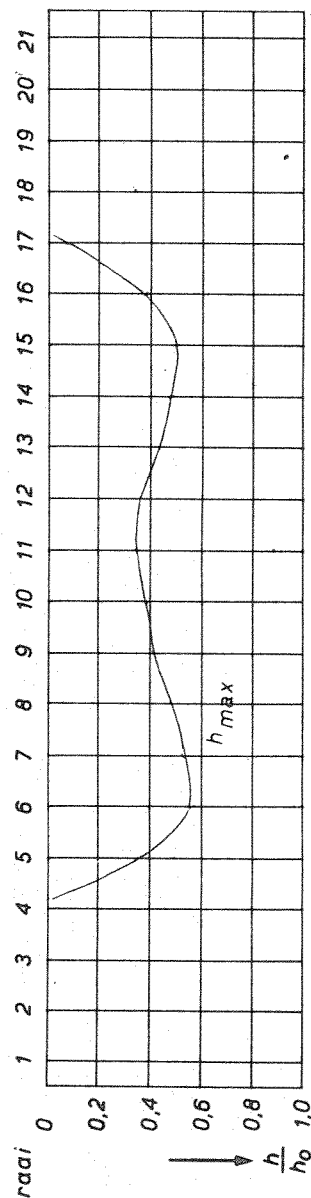
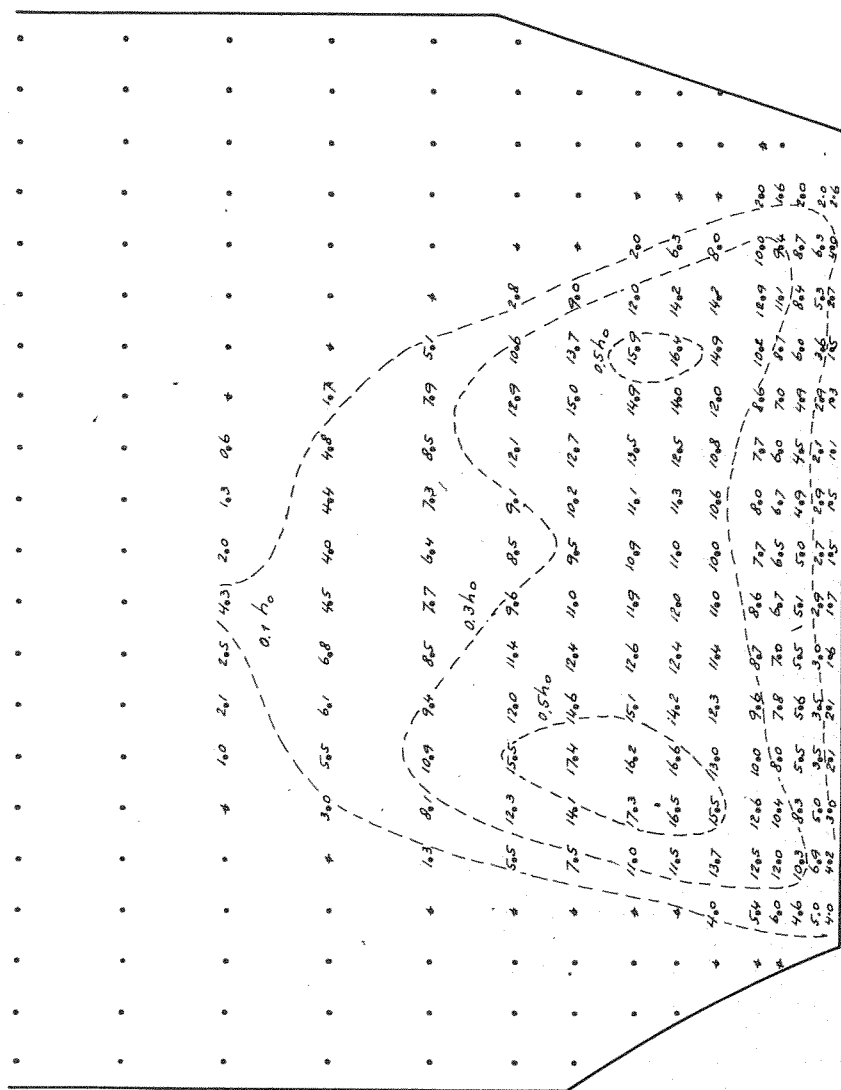
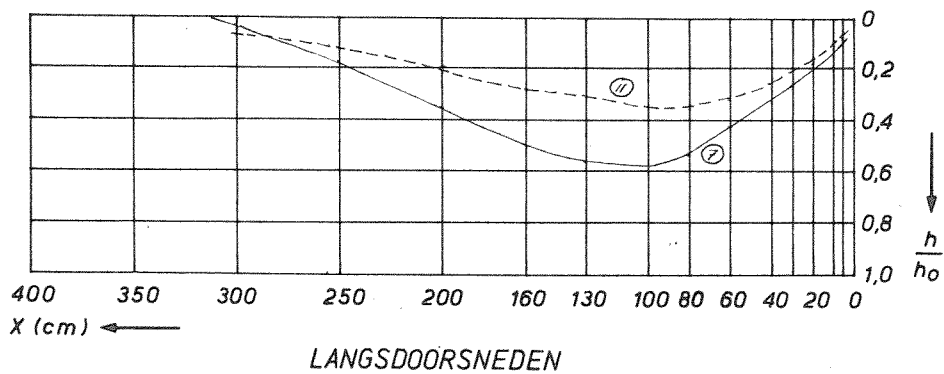
$h_0 = 29.6 \text{ cm}$

R.R.

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FIG.II-43



SITUATIE : T 6

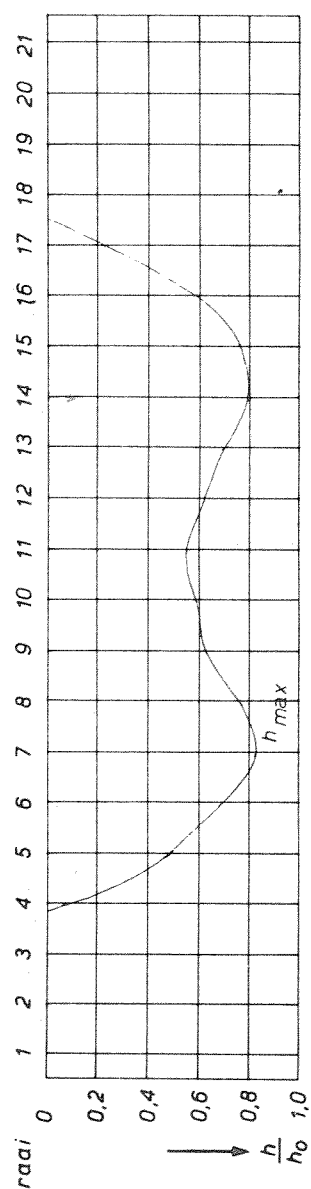
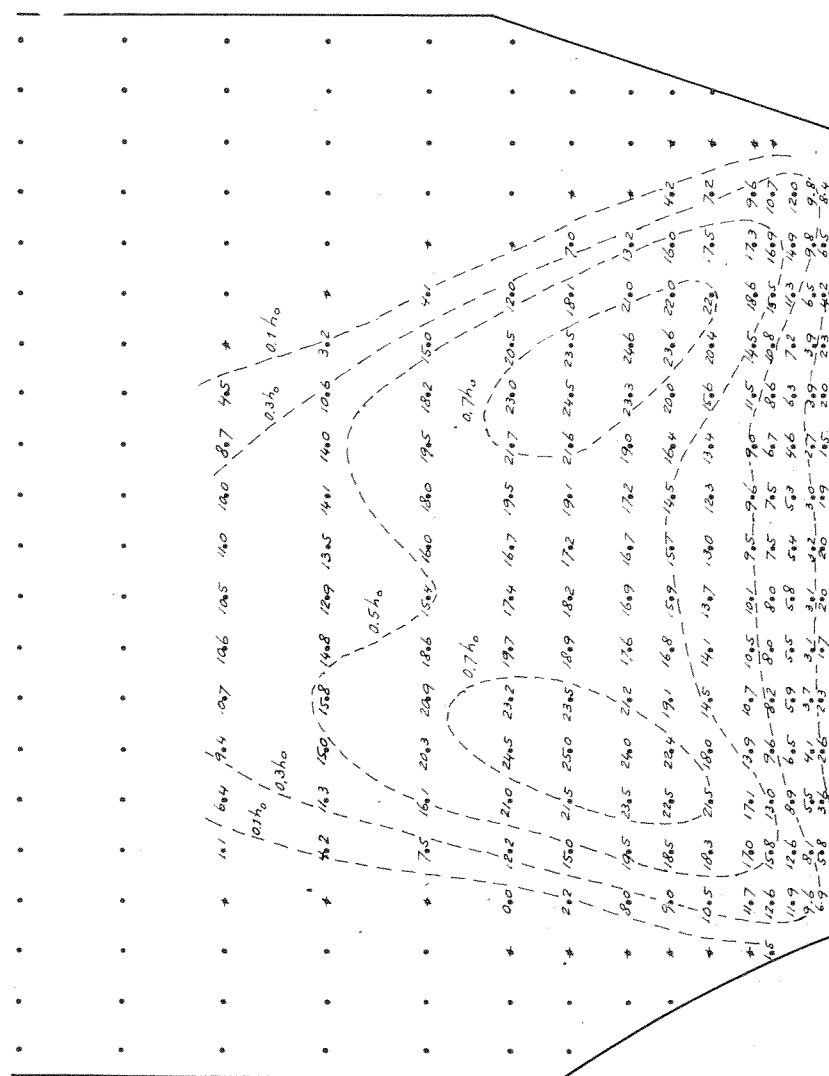
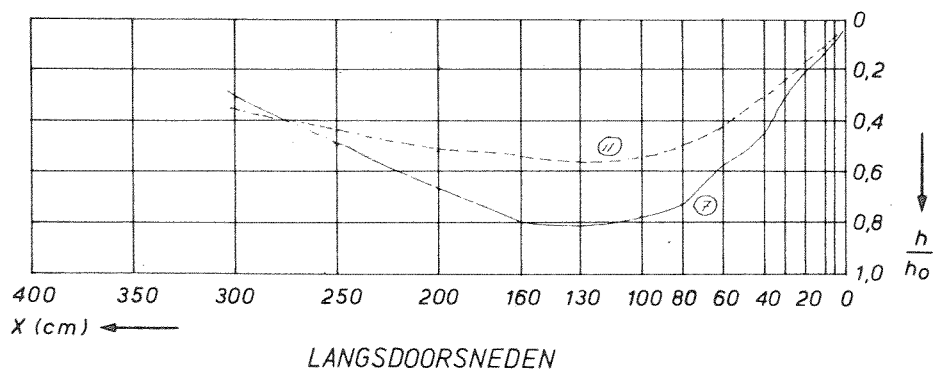
$Q = 203 \text{ l/s}$

$t = 1.00 - 1.20$

$t/t_{1/2} = 1.17$

$h_0 = 30.7 \text{ cm}$

R.R.



SITUATIE : T 6

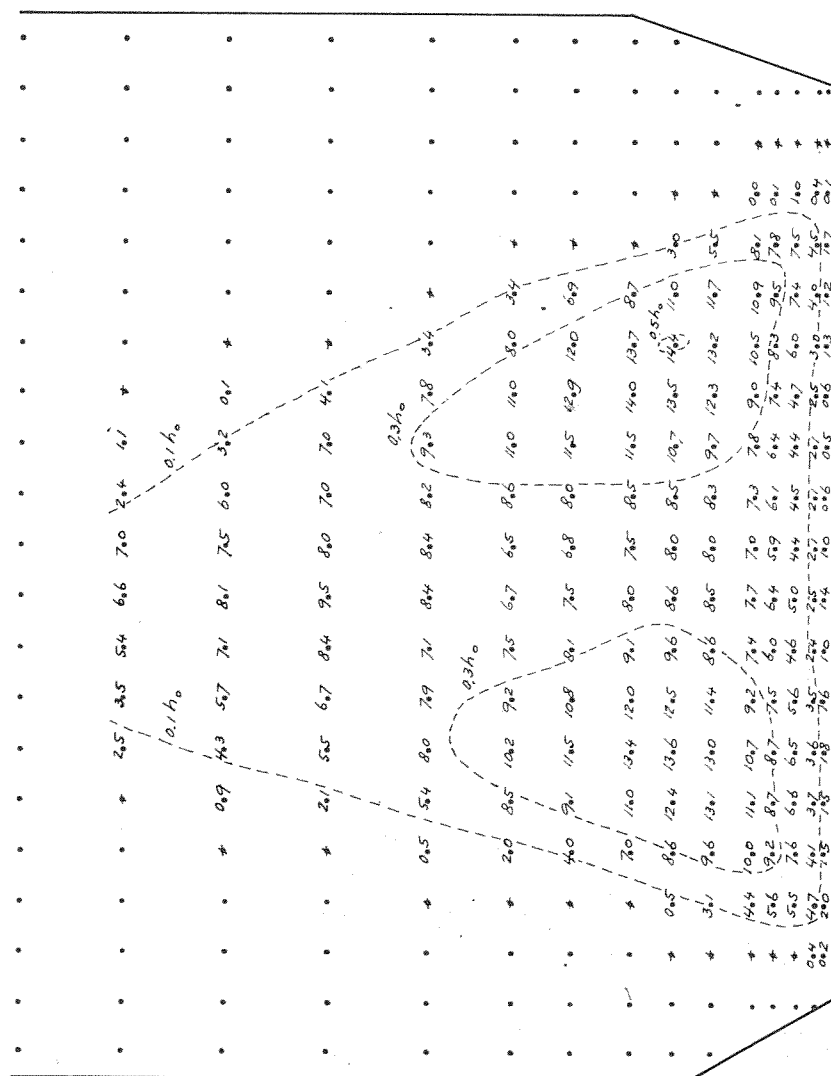
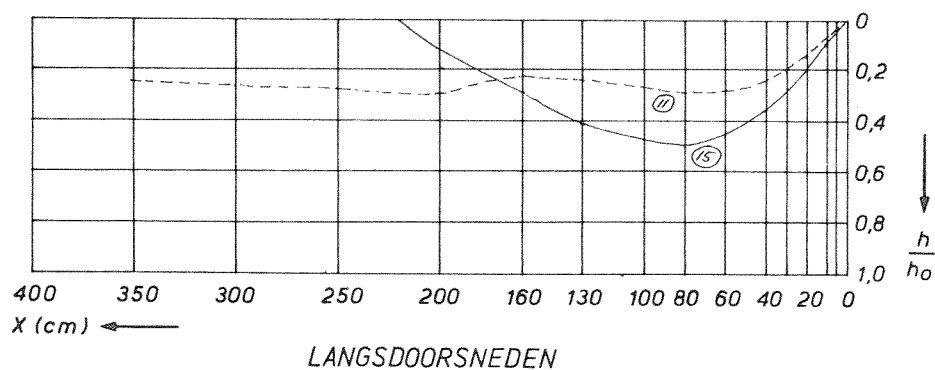
$Q = 203 \text{ l/s}$

$t = 2.00 - 2.22$

$t/t_{1/2} = 2.2$

$h_0 = 30.7 \text{ cm}$

R.R.



SITUATIE : T 7

$Q = 122 \text{ l/s}$

$t = 13.00 - 13.15$

$t/t'_{1/2} = 0.94$

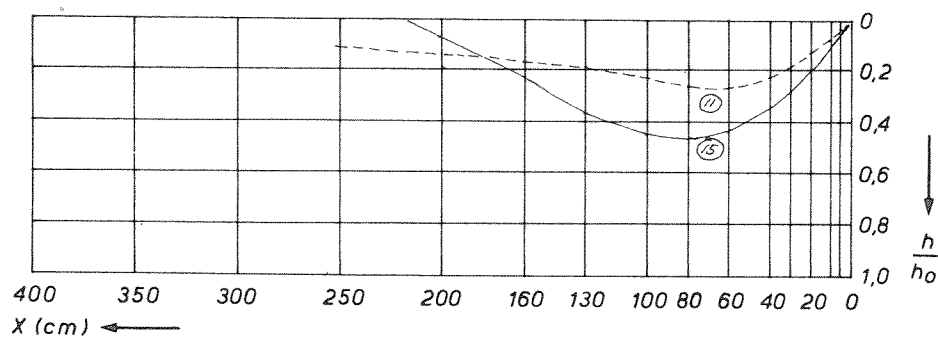
$h_0 = 29.0 \text{ cm}$

R.R.

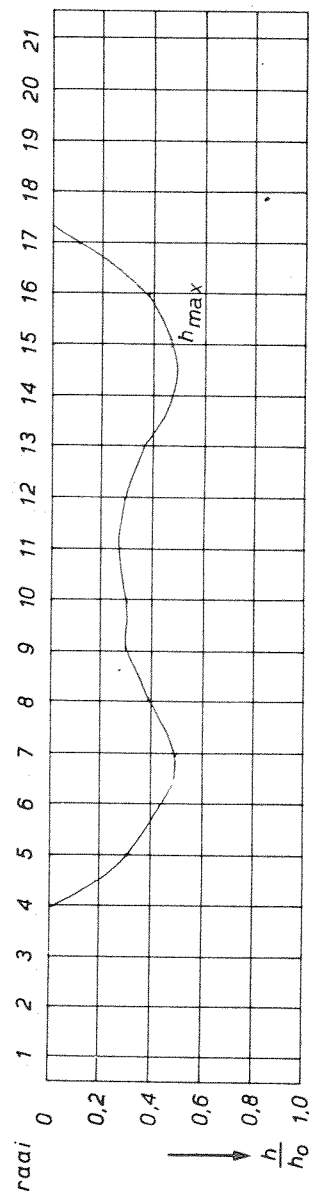
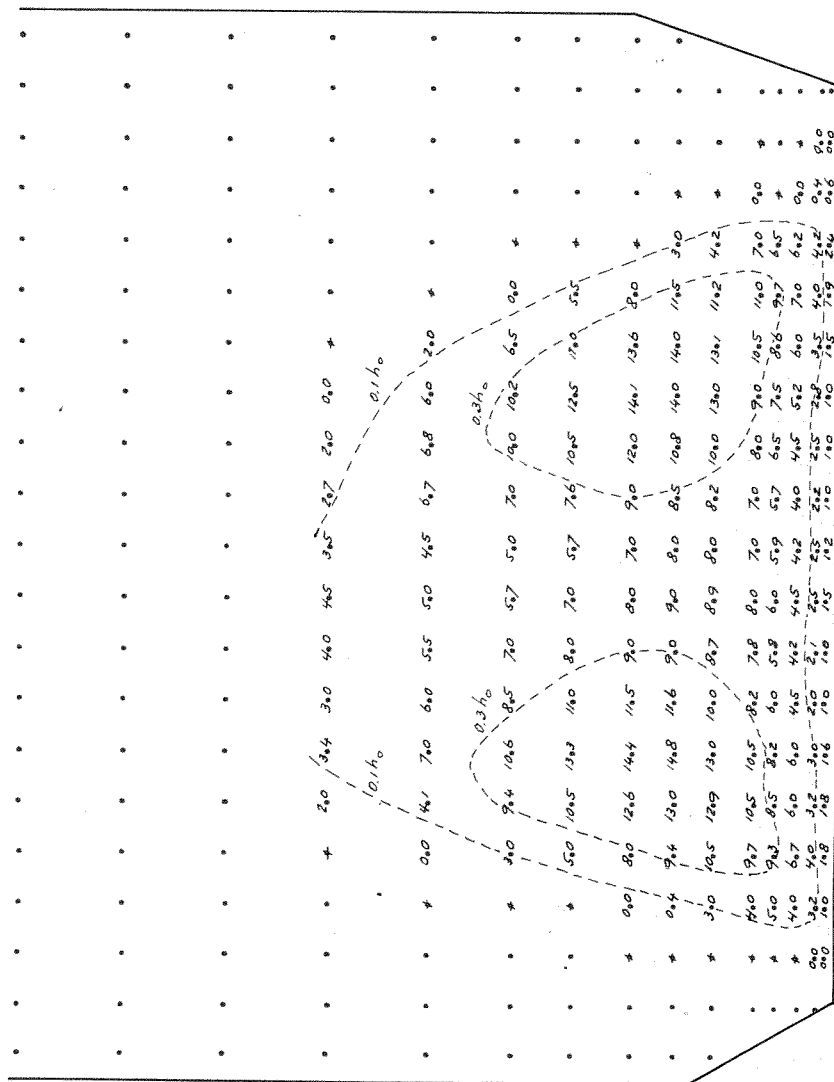
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FIG.II-46



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SITUATIE : T 7

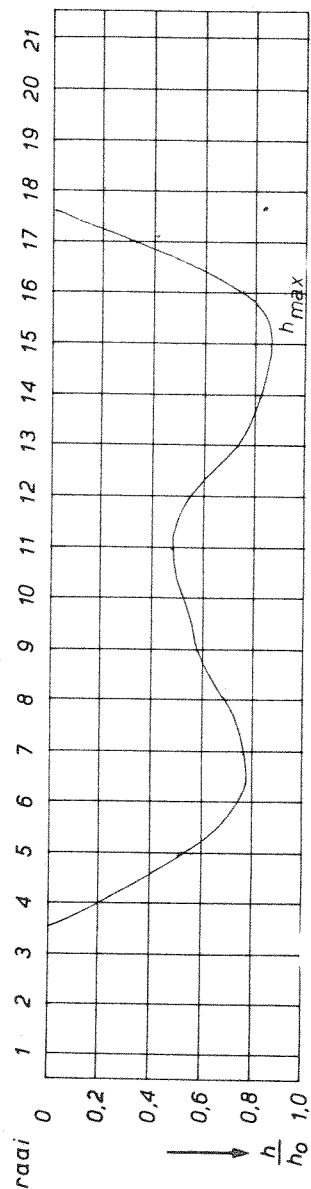
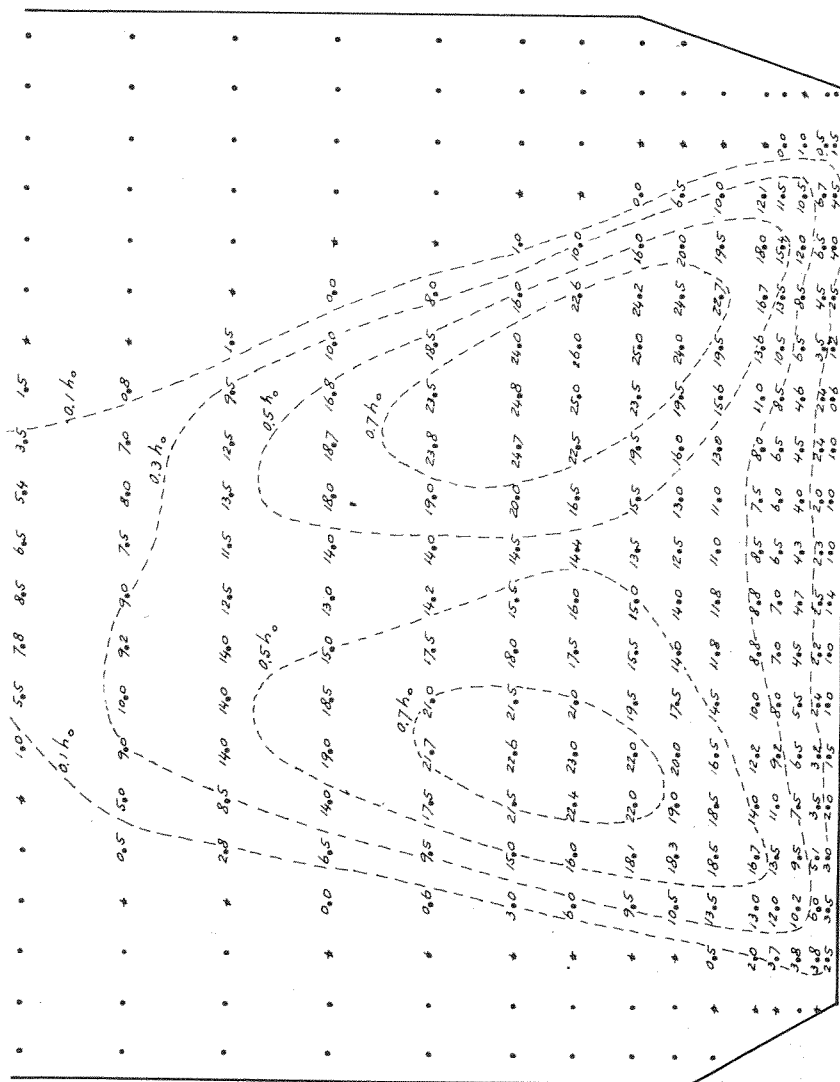
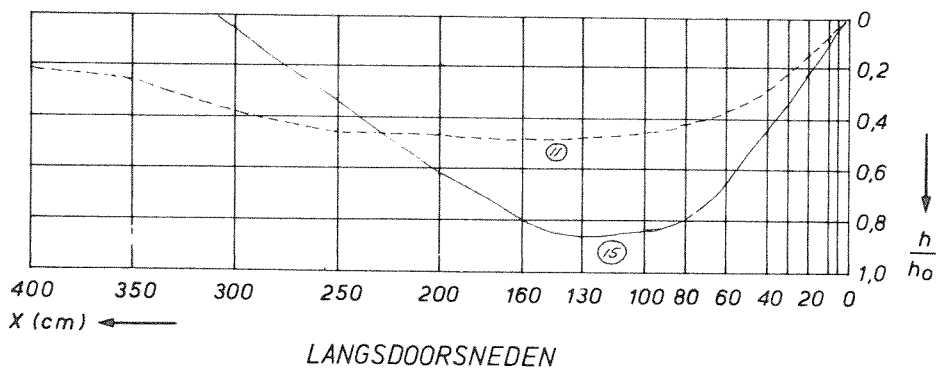
$Q = 152 \text{ l/s}$

$t = 4.00 - 4.17$

$t/t^{1/2} = 0.96$

$h_0 = 29.9 \text{ cm}$

R.R.



SITUATIE : T 7

$Q = 152 \text{ l/s}$

$t = 12.00 - 12.20$

$t/t_{1/2} = 2.83$

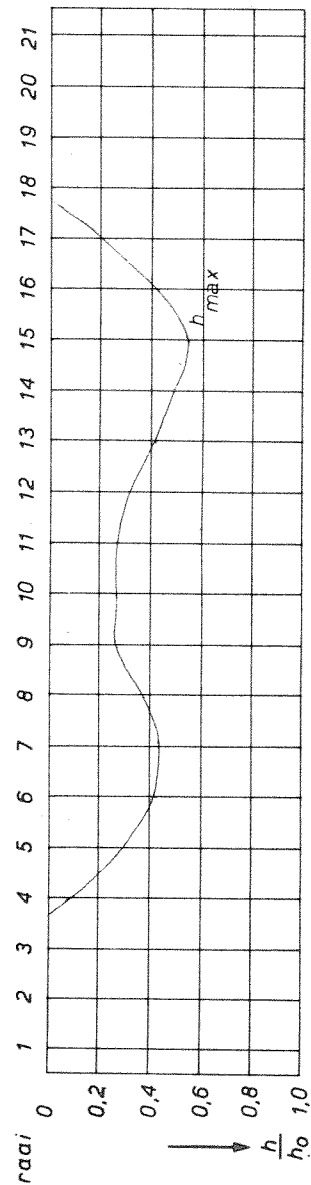
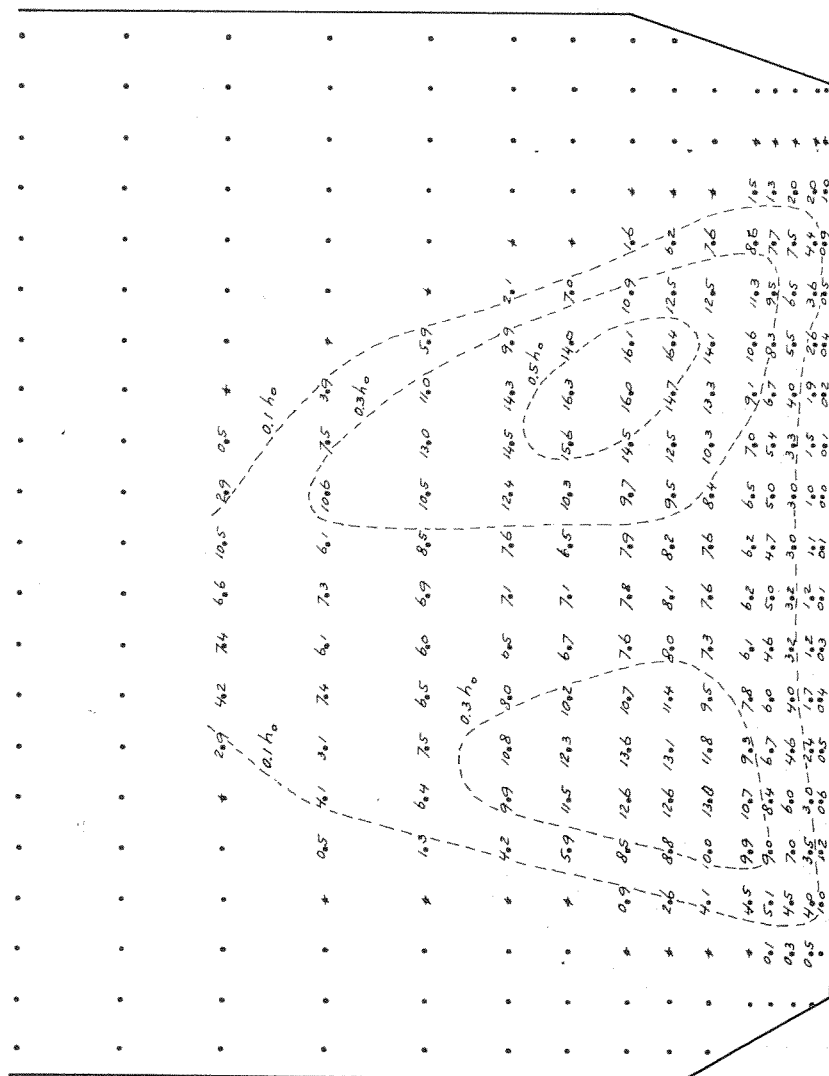
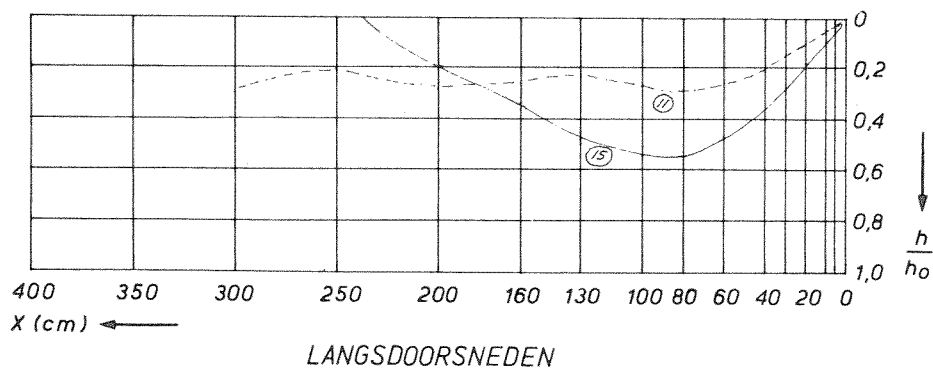
$h_0 = 29.9 \text{ cm}$

R.R.

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FIG.II-48



SITUATIE : T 7 A

$Q = 152 \text{ l/s}$

$t = 7.00 - 7.20$

$t/t_{1/2} = 1.09$

$h_0 = 29.7 \text{ cm}$

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FIG.II- 49

R.R.

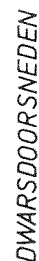
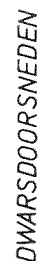
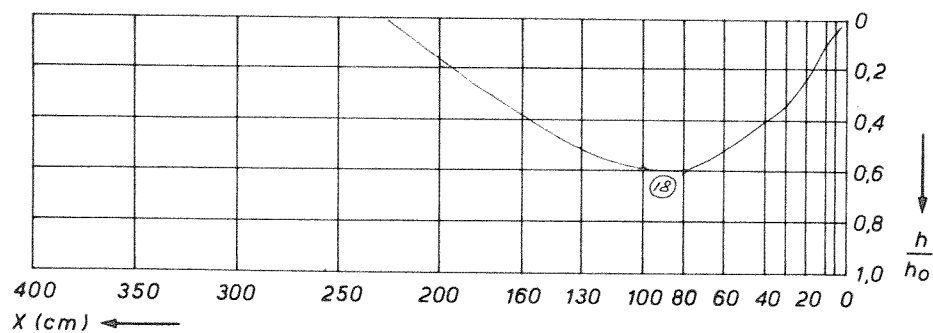
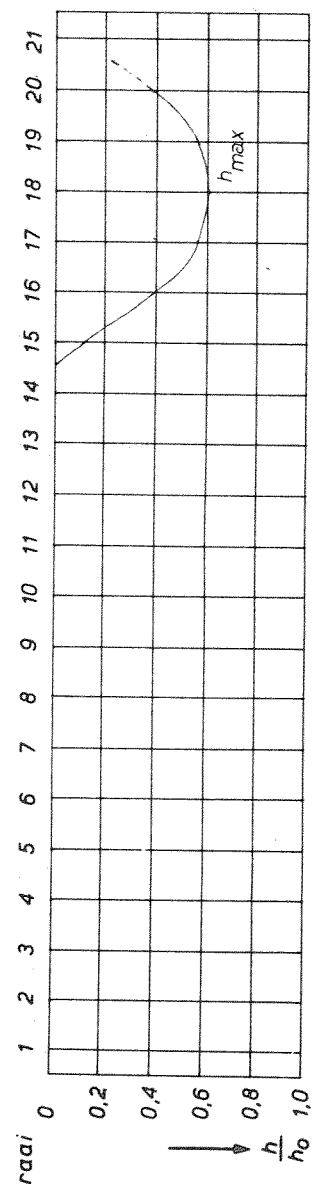
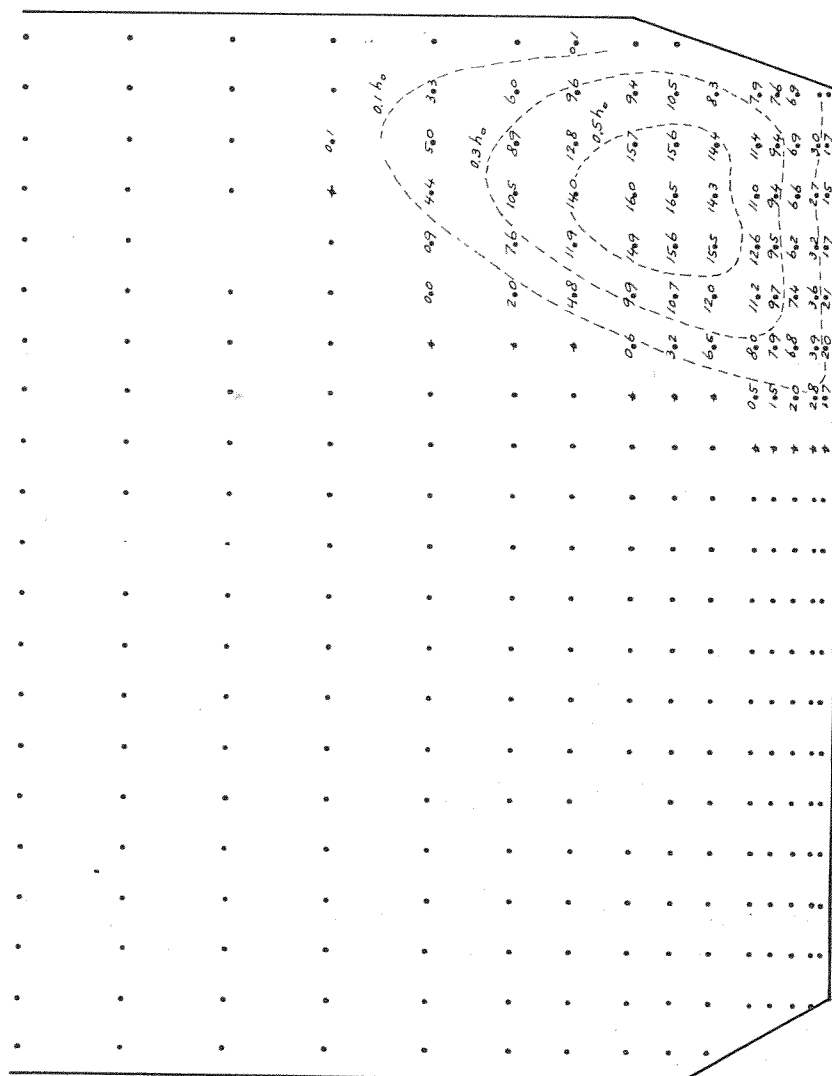


FIG. II-50



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SITUATIE : T 7 B

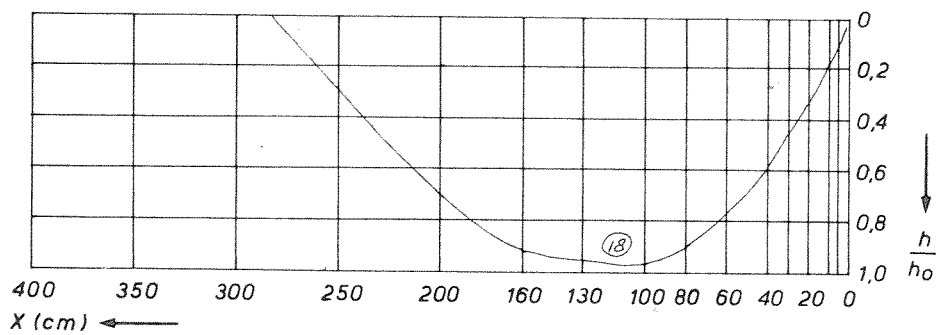
$Q = 51 \text{ l/s}$

$t = 2.00 - 2.15$

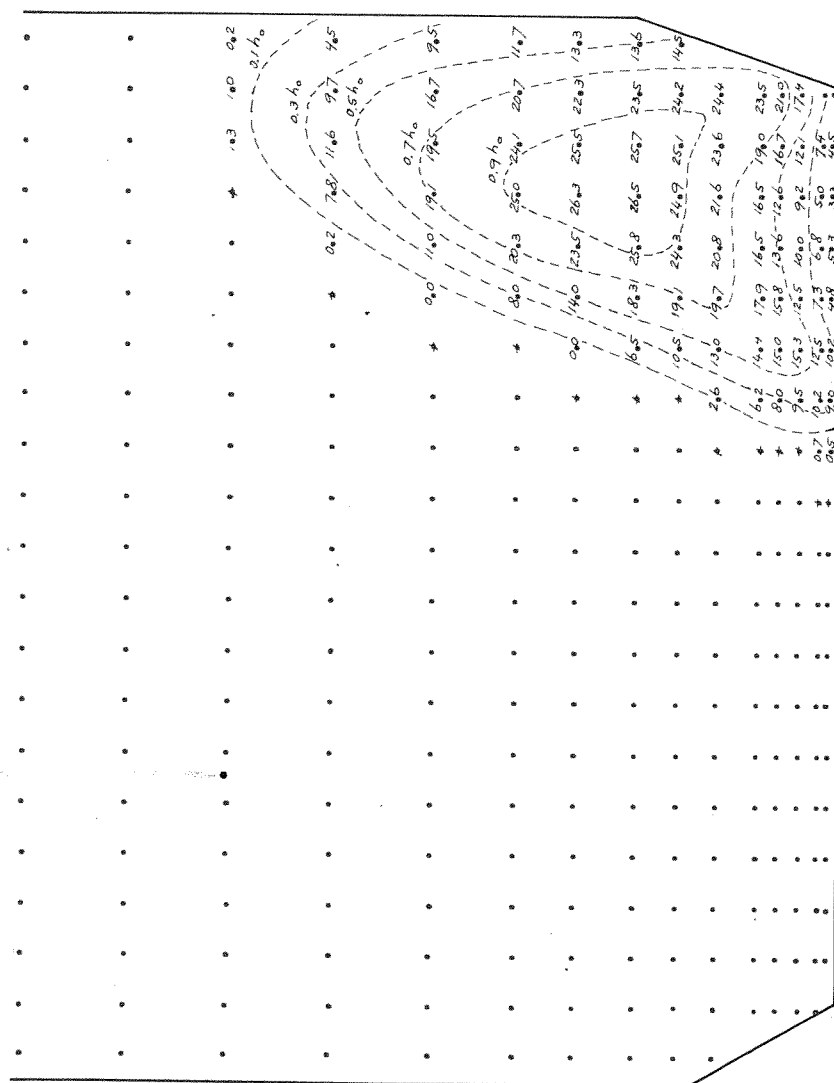
$t/t_{1/2} = 1.33$

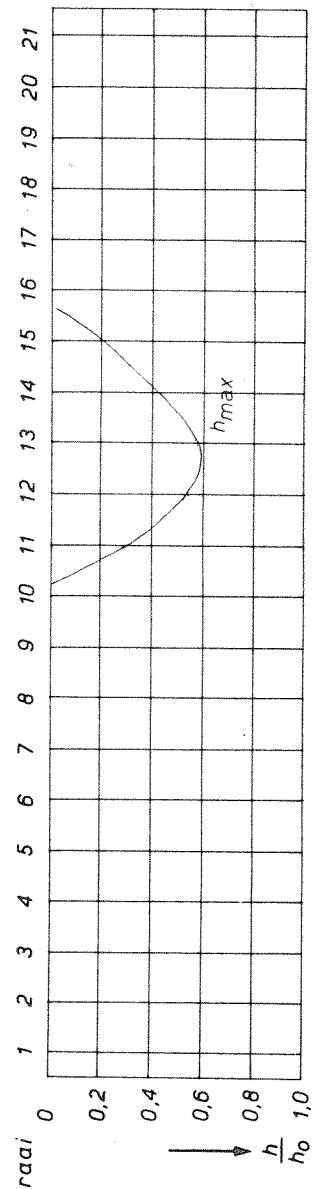
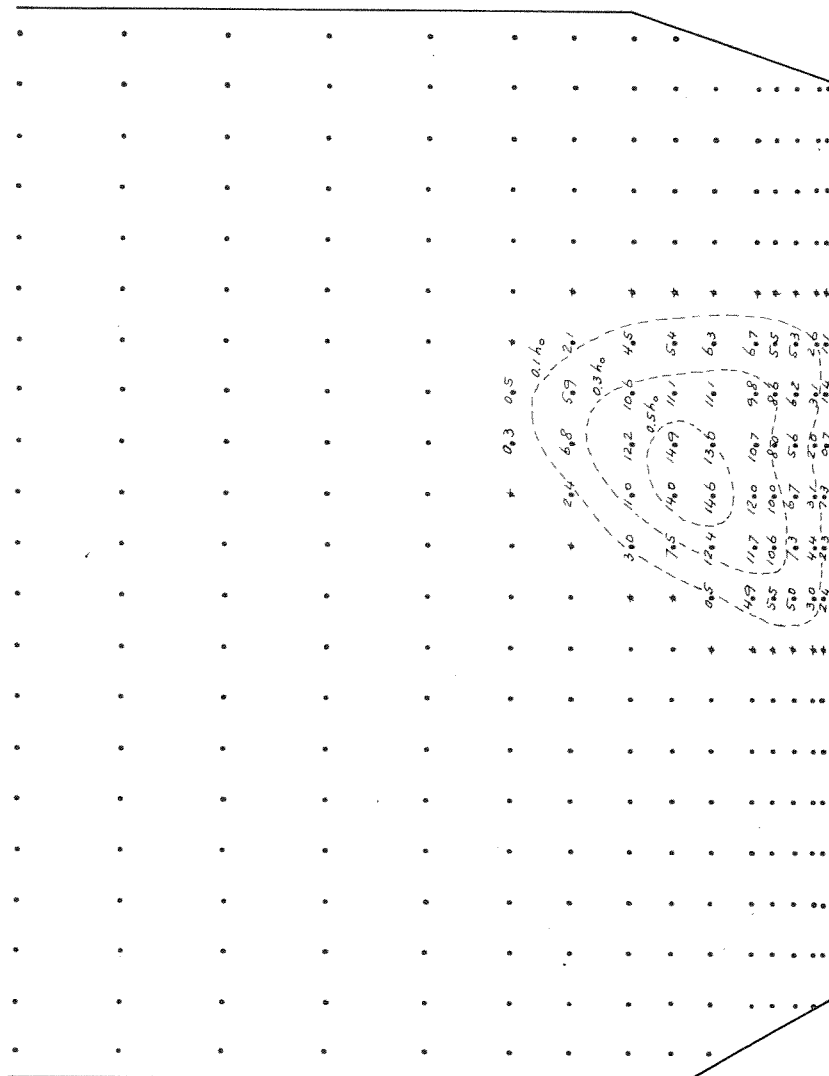
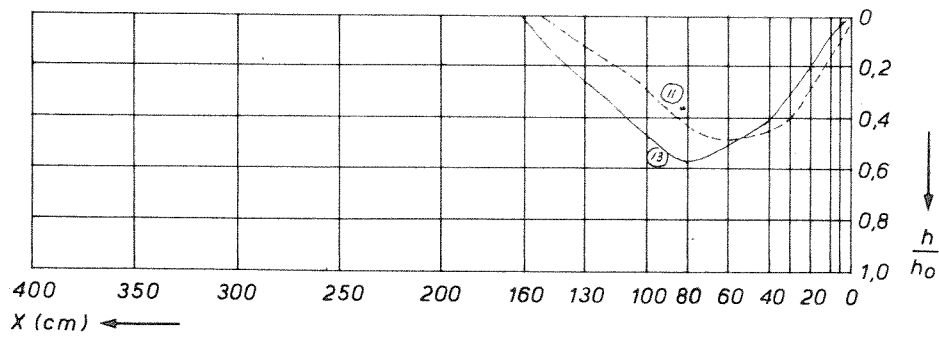
$h_0 = 27.3 \text{ cm}$

R.R.



LANGSDOORSNEDEN





SITUATIE : T 7 C

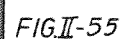
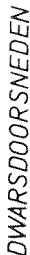
$$Q = 26 \text{ l/s}$$
$$t = 2.00 - 2.13$$
$$t/t^{1/2} = 1.17$$
$$h_0 = 25.9 \text{ cm}$$

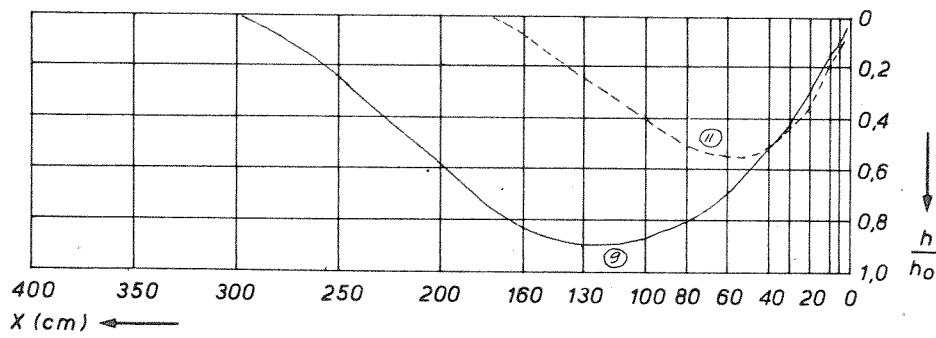
R.R.

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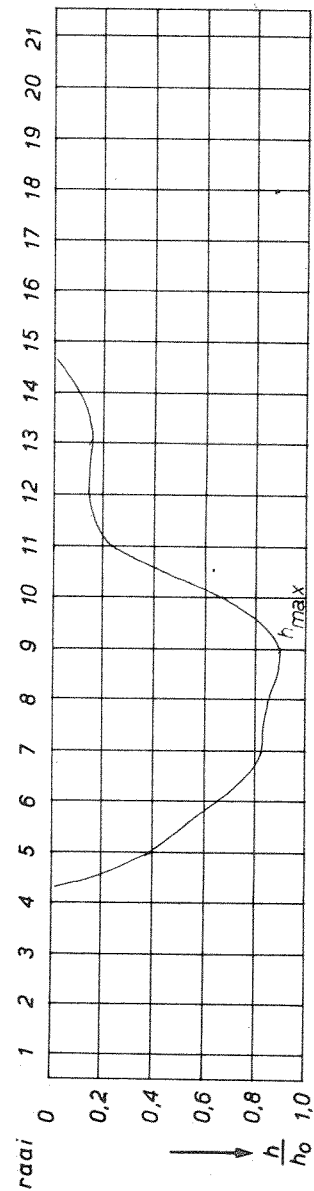
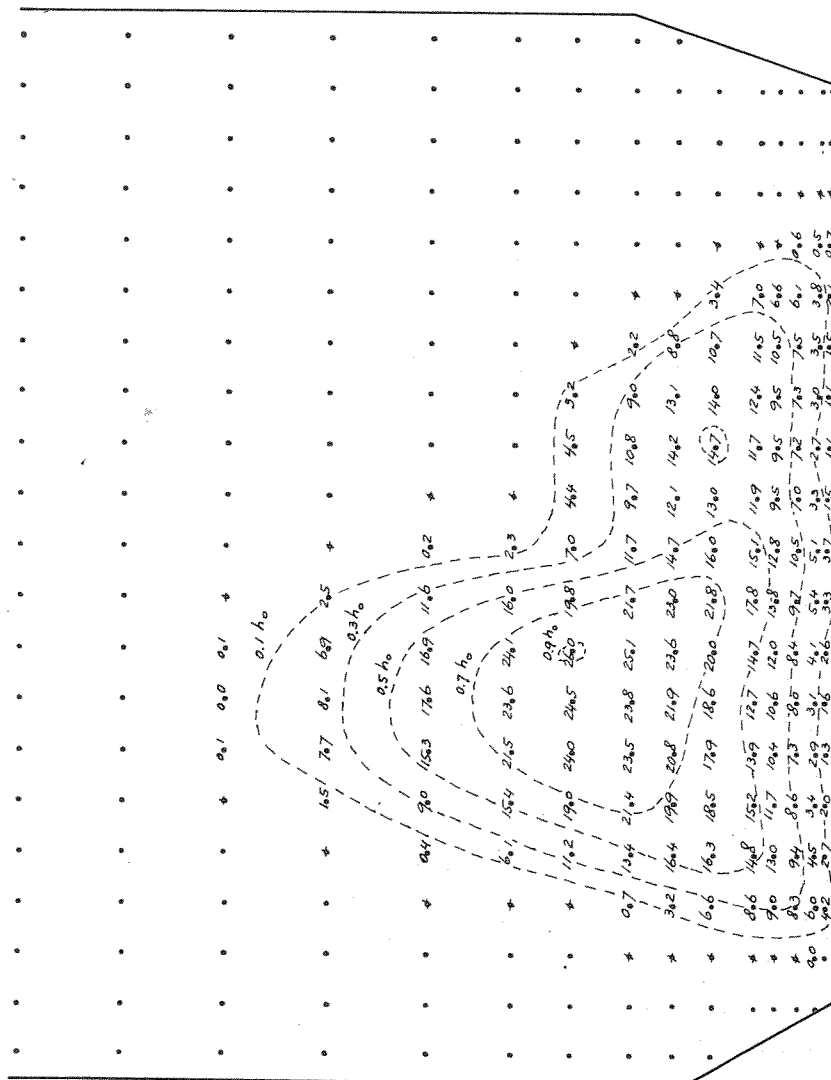
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FIG. II-53





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SITUATIE : T 7 D

$Q = 102 \text{ l/s}$

$t = 2.00 - 2.21$

$t/t^{1/2} = 24$

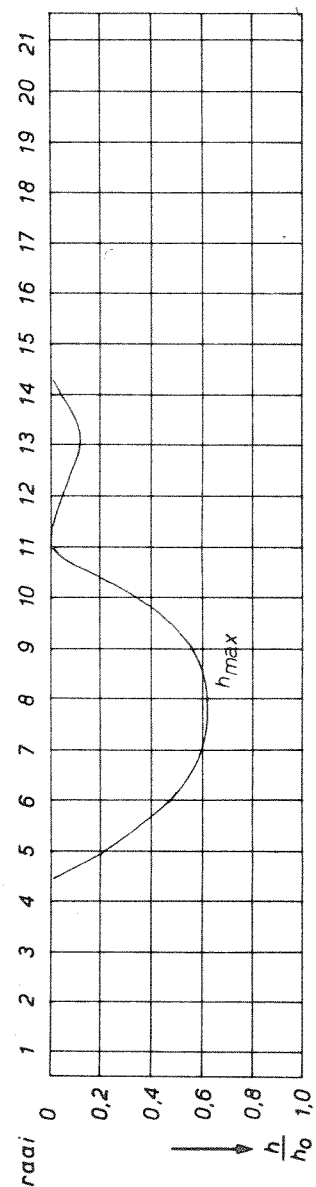
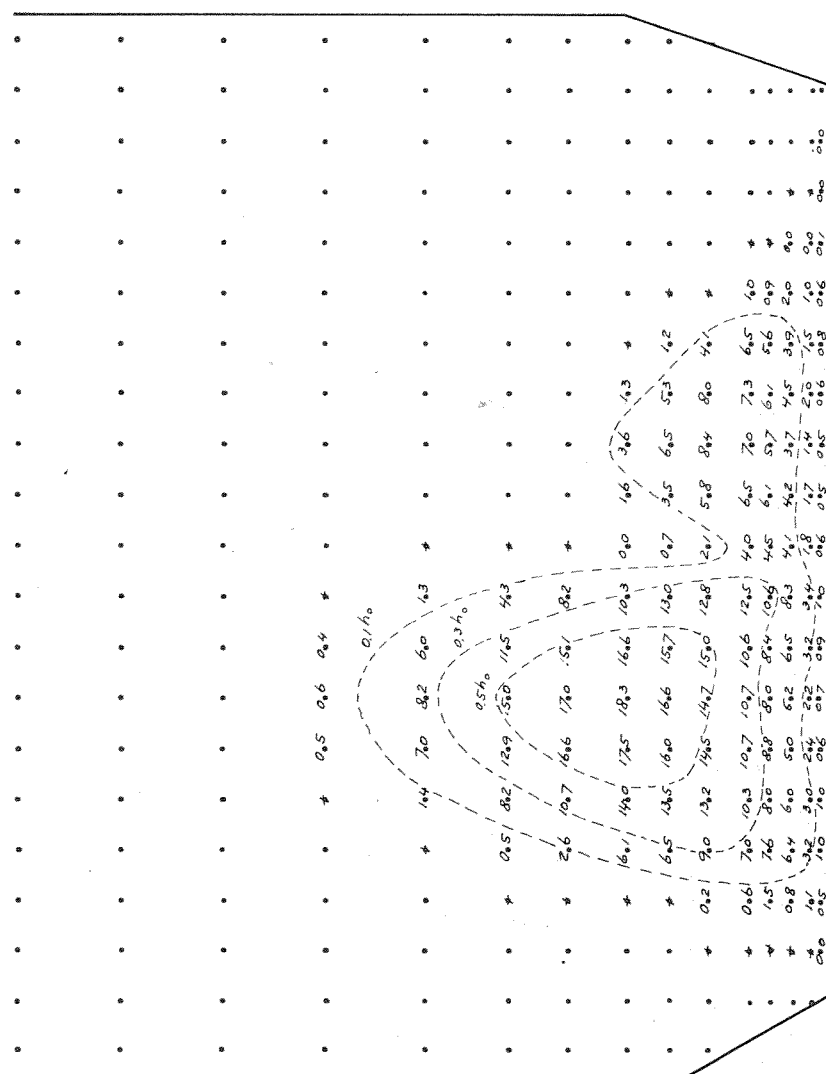
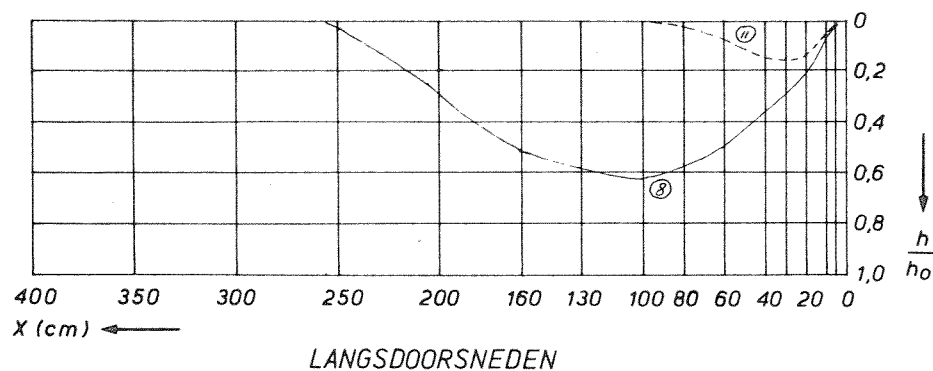
$h_0 = 29.0 \text{ cm}$

R.R.

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FIG.II-56



SITUATIE : T 7D

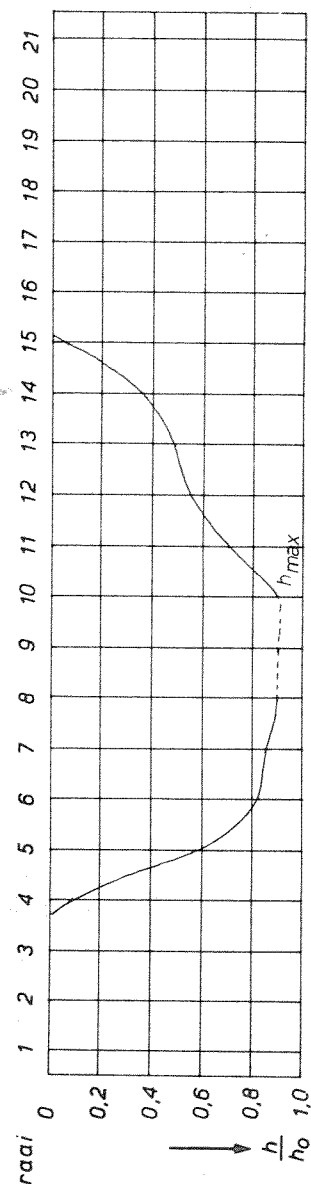
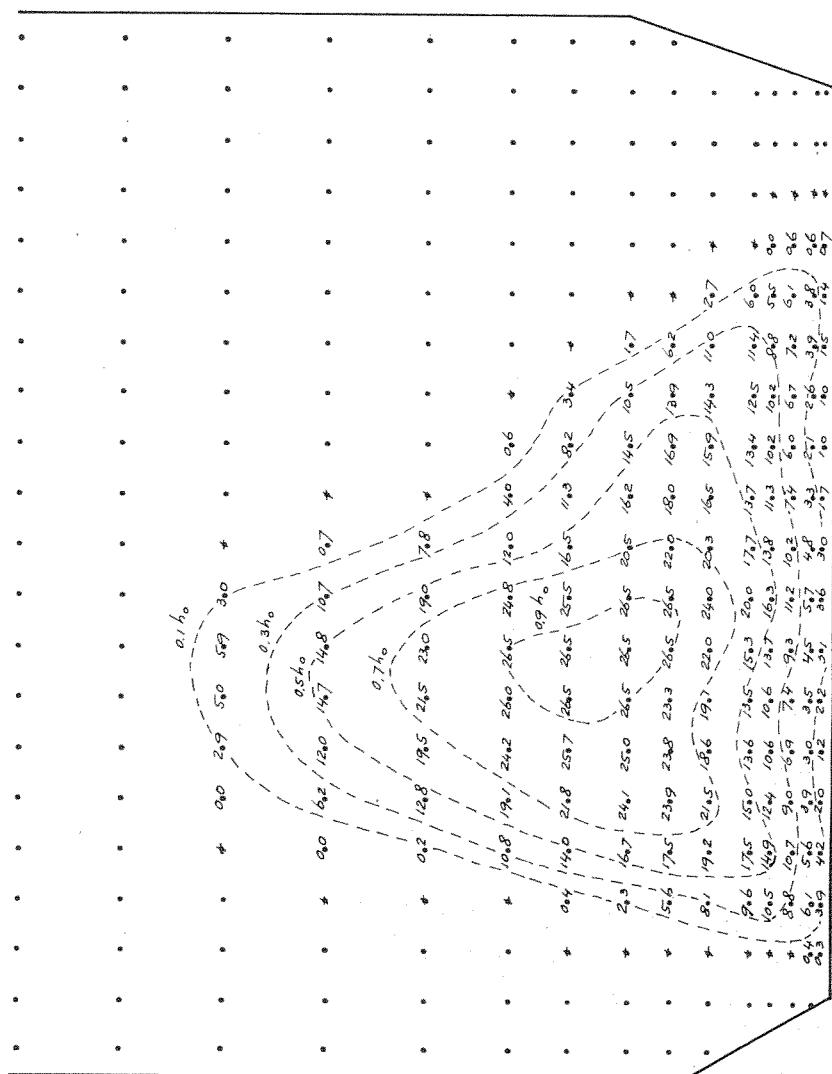
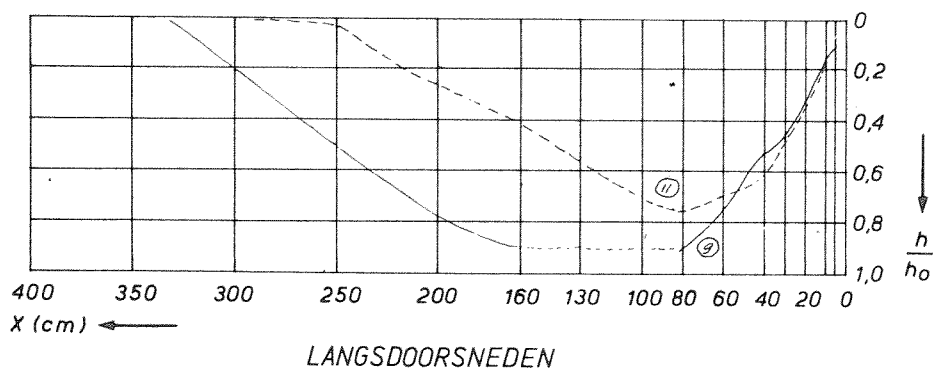
$Q = 122 \text{ l/s}$

$t = 0.30 - 0.46$

$t/t^{1/2} = 1.27$

$h_0 = 29.4 \text{ cm}$

R.R.



SITUATIE : T 7 D

$Q = 122 \text{ l/s}$

$t = 1.00 - 1.25$

$t/t_{1/2} = 2.42$

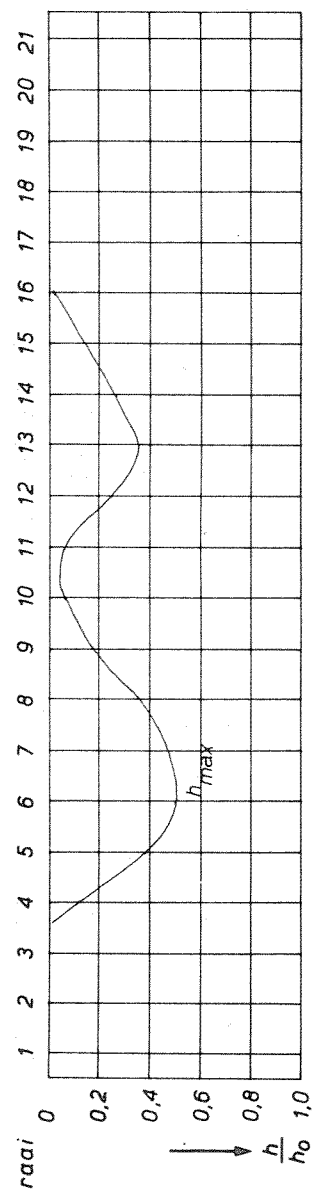
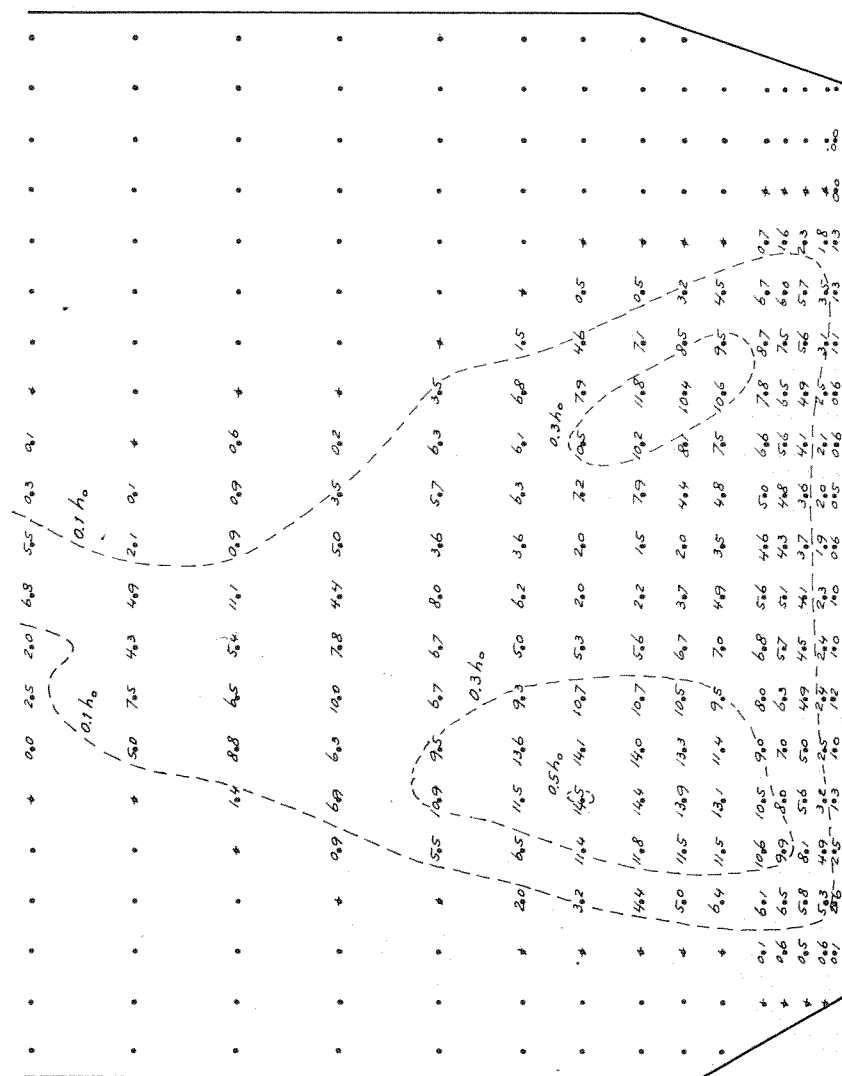
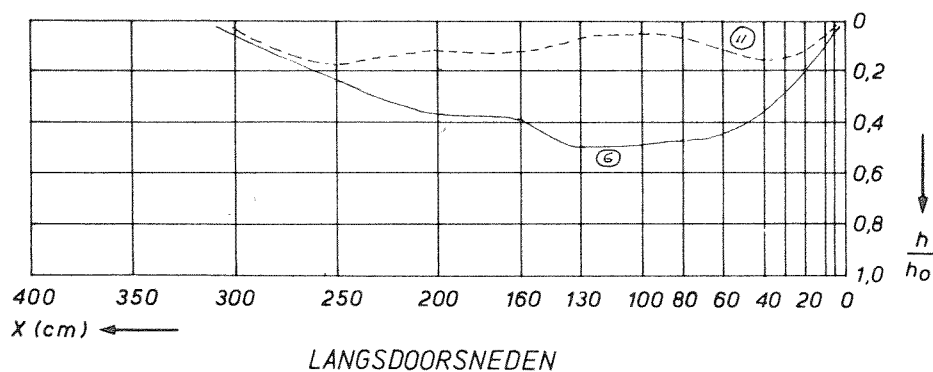
$h_0 = 29.4 \text{ cm}$

R.R.

WATERLOOPKUNDIG LABORATORIUM

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FIG.II-58



SITUATIE : T 7 E

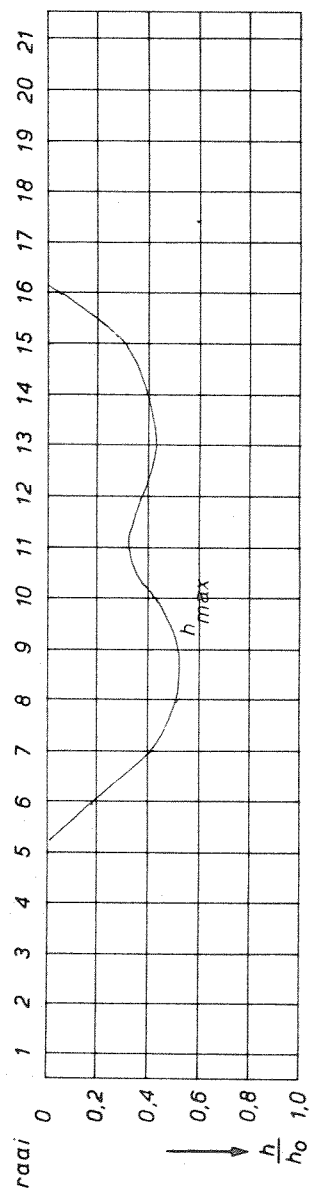
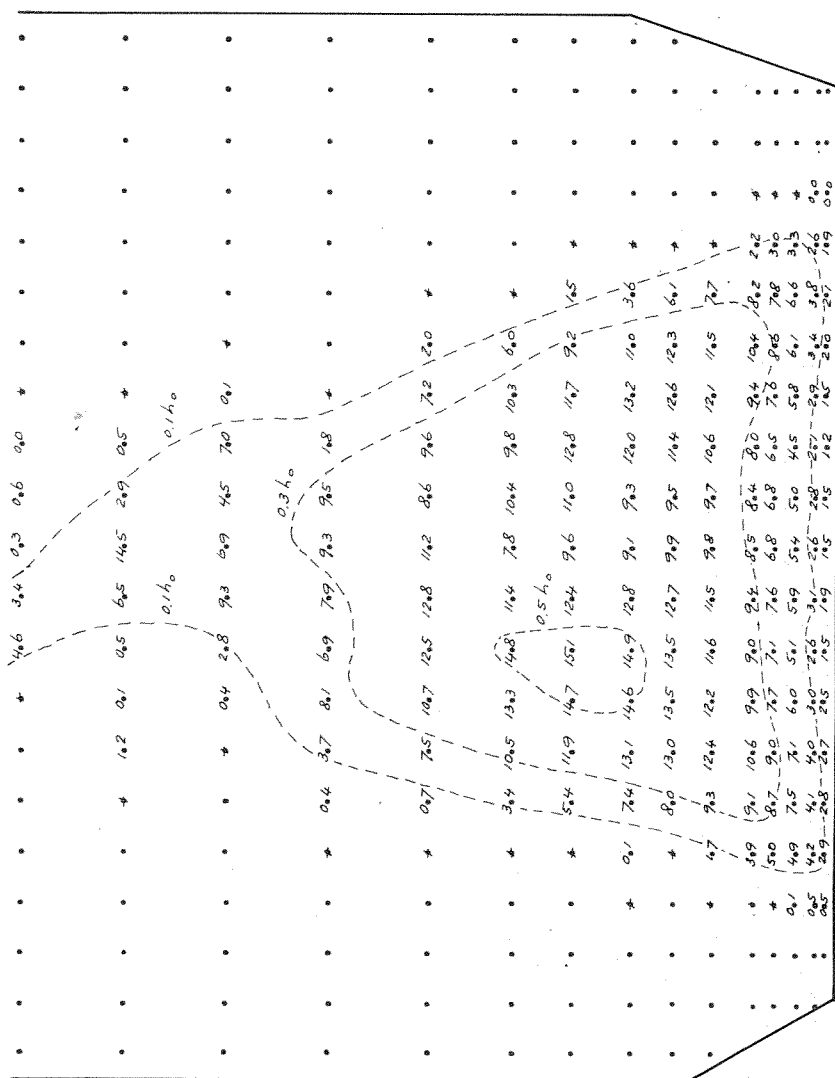
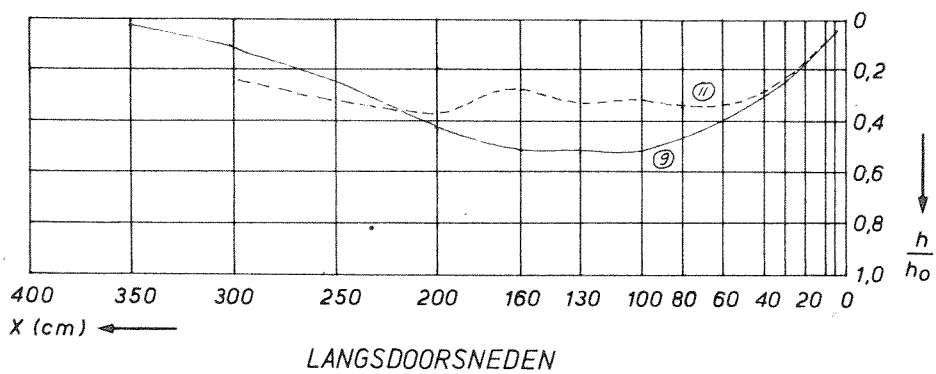
$Q = 122 \text{ l/s}$

$t = 20.00 - 20.19$

$t/t_{1/2} = 0.96$

$h_0 = 29.3 \text{ cm}$

R.R.



SITUATIE : T 7F

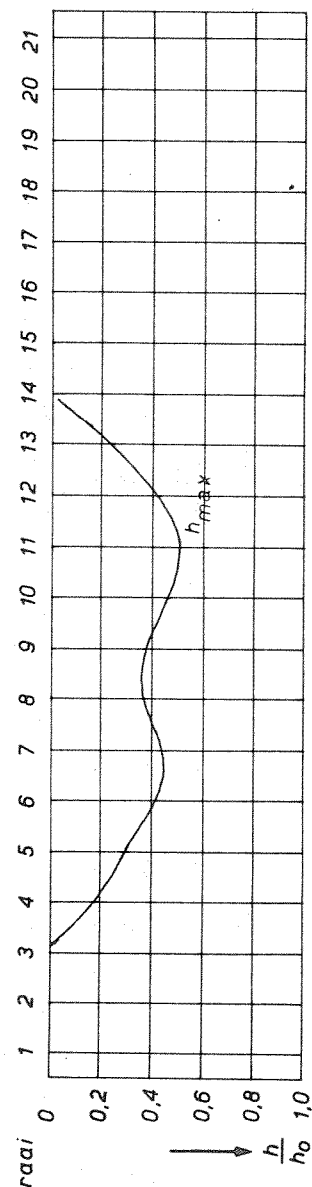
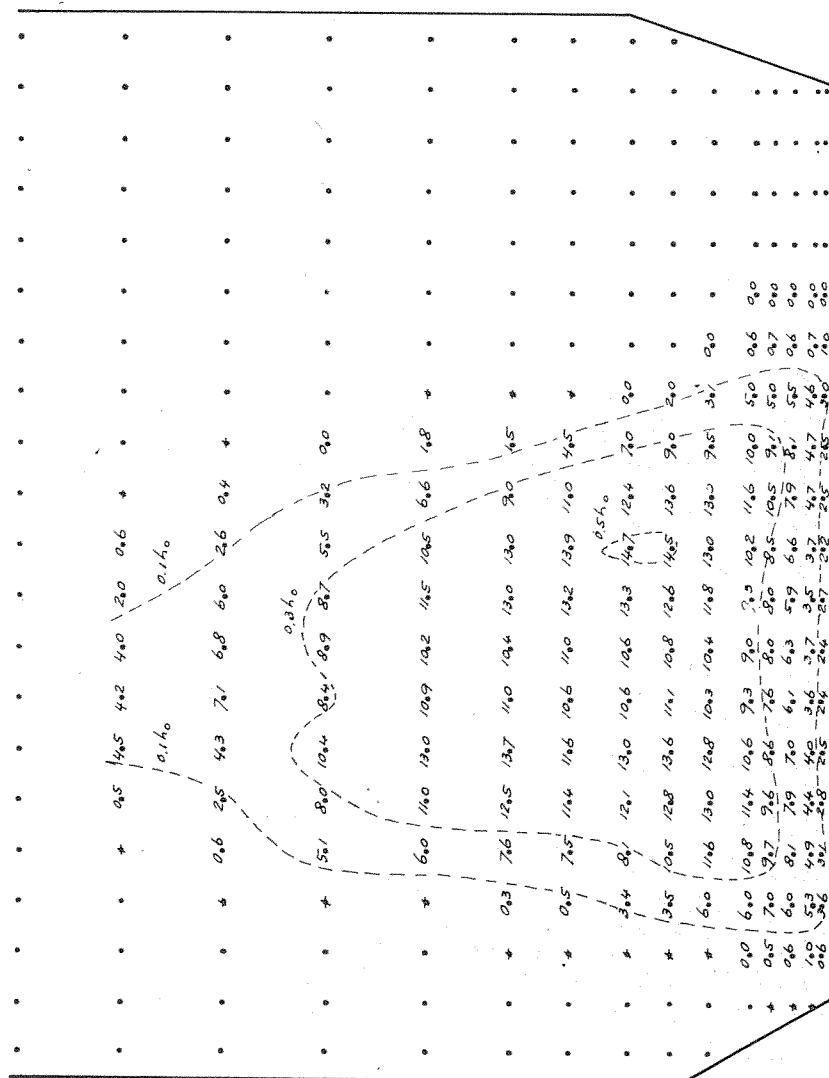
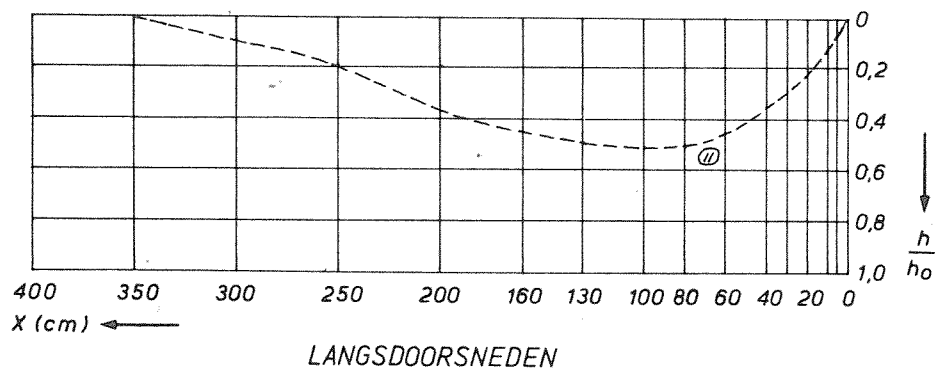
$Q = 102 \text{ l/s}$

$t = 25.00 - 25.17$

$t/t_{1/2} = 0.97$

$h_0 = 28.9 \text{ cm}$

R.R.



SITUATIE : T 7 G

$Q = 102 \text{ l/s}$

$t = 14.00 - 14.20$

$t/t_{1/2} = 0.98$

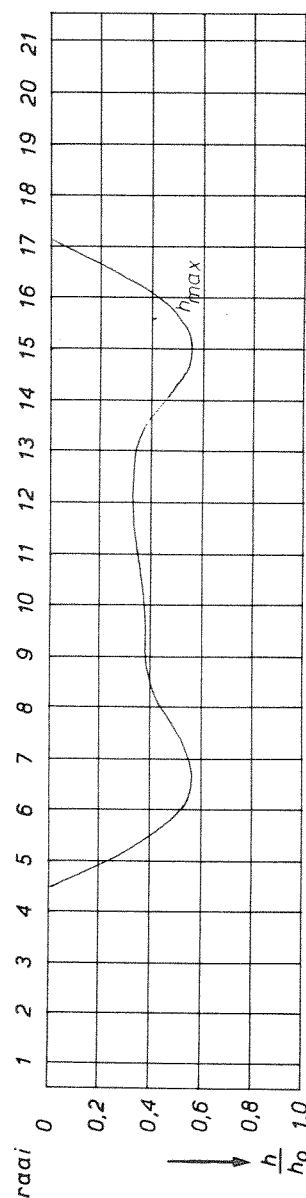
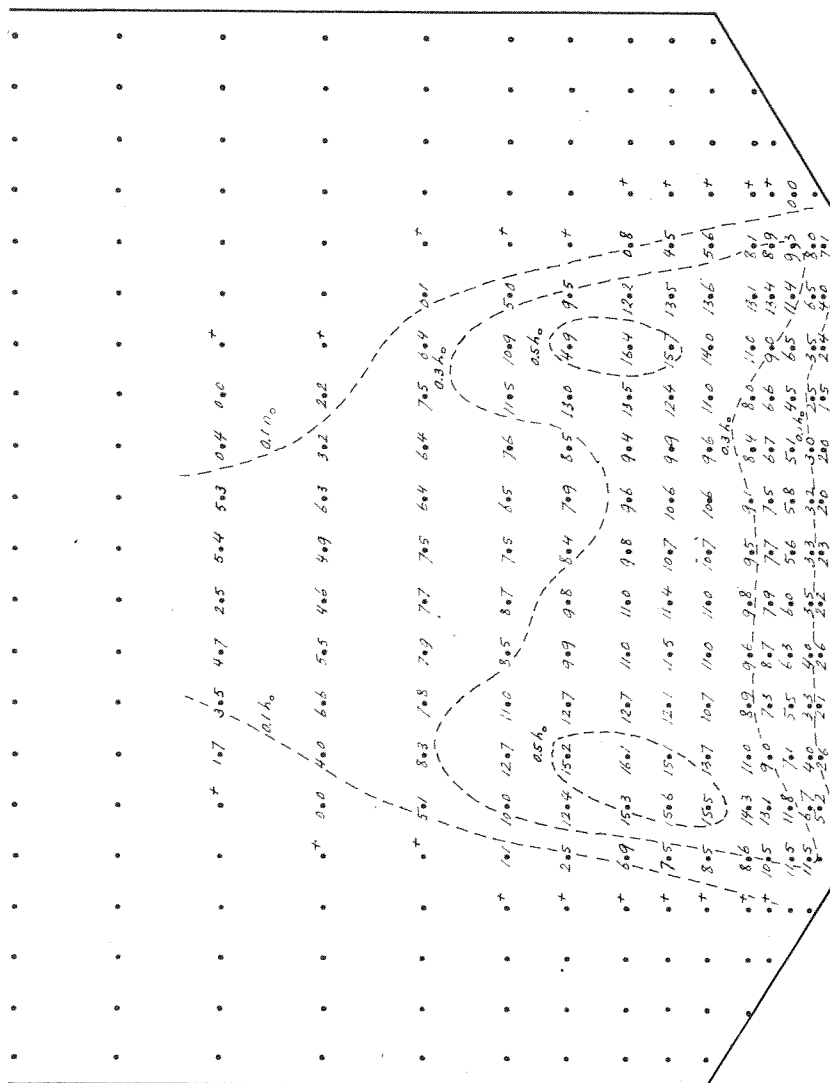
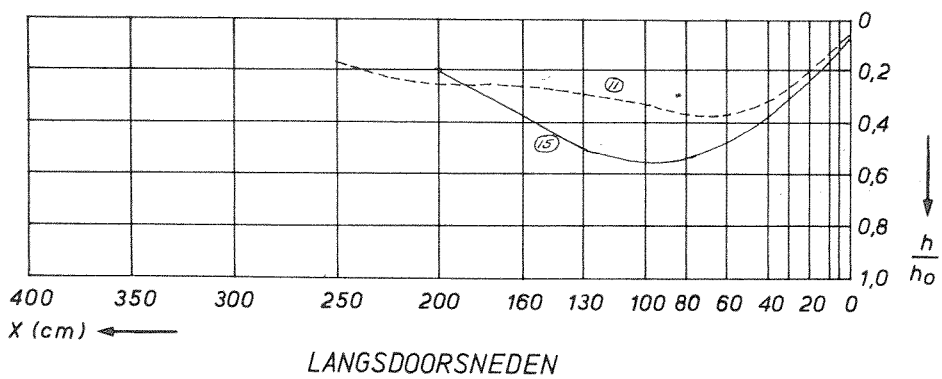
$h_0 = 28.7 \text{ cm}$

R.R.

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FIG.II-61



SITUATIE : T 8

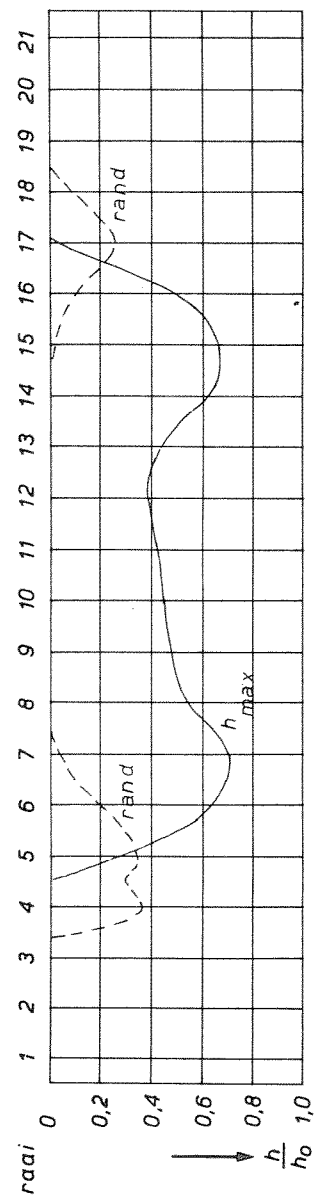
$Q = 122 \text{ l/s}$

$t = 13.00 - 13.14$

$t/t_{1/2} = 1.14$

$h_0 = 29.5 \text{ cm}$

R.R.

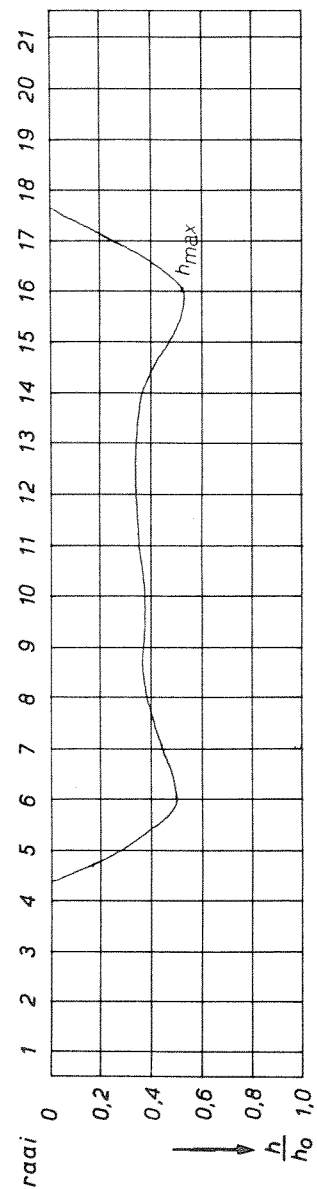
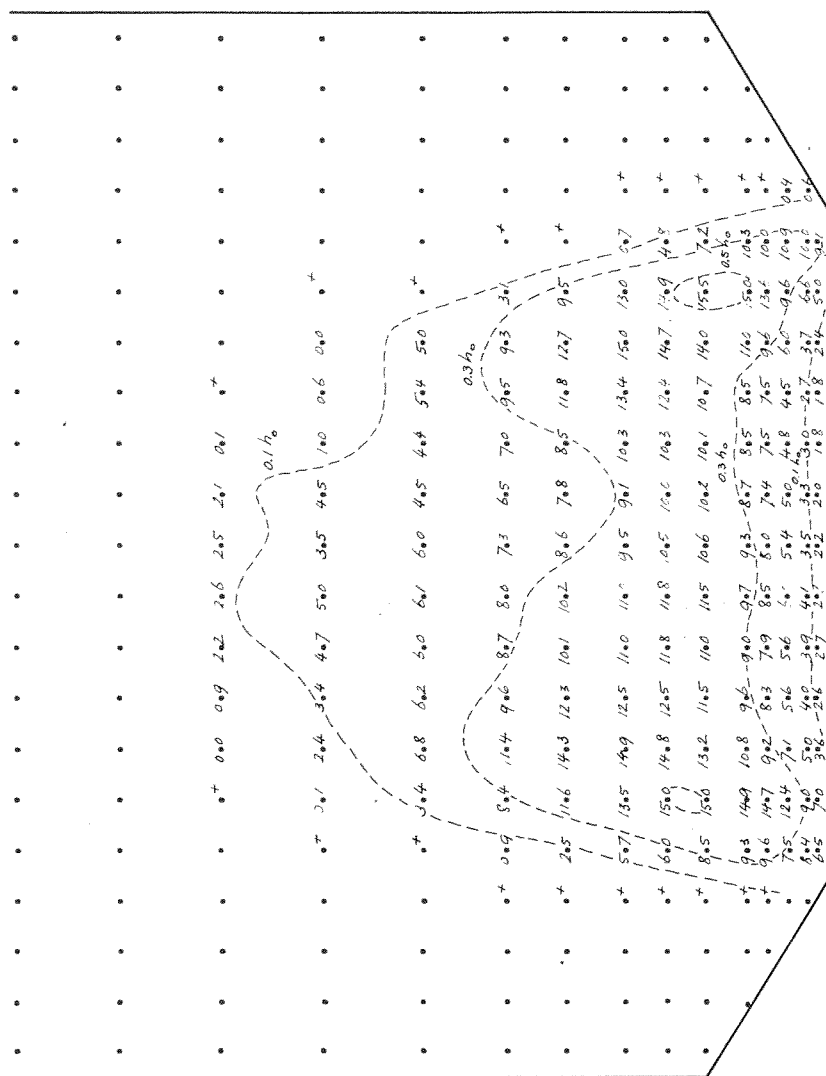
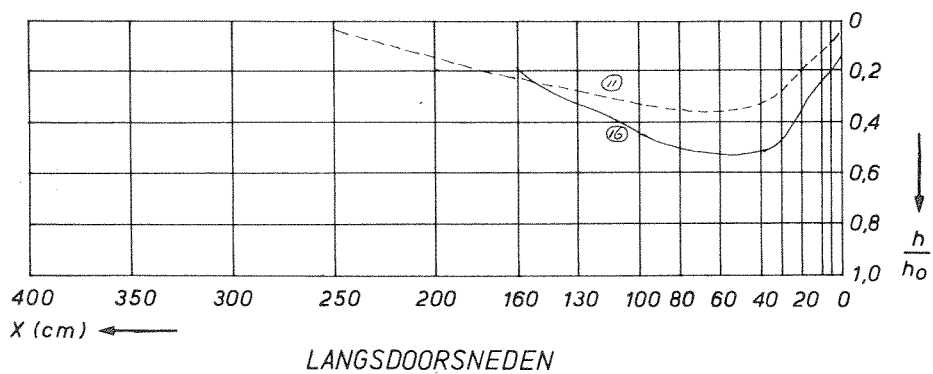


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$$h_0 = 29.5 \text{ cm}$$

R.R.

FIG. II-63



SITUATIE : T 8

$Q = 152 \text{ l/s}$

$t = 3.00 - 3.18$

$t/t_{1/2} = 1.02$

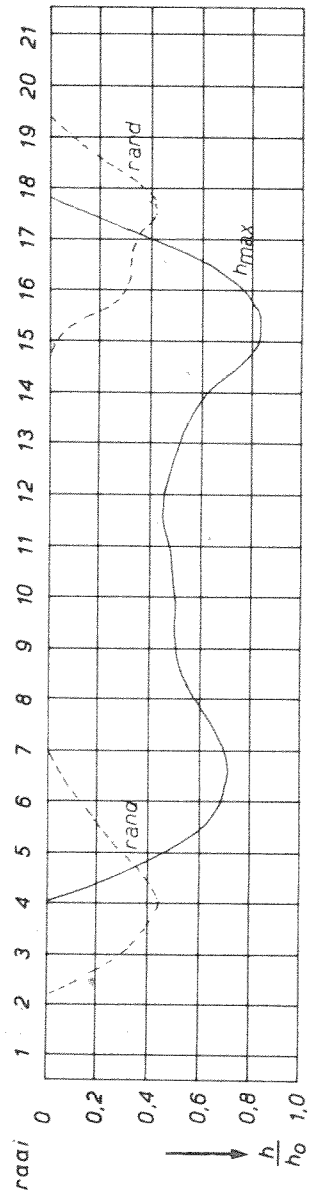
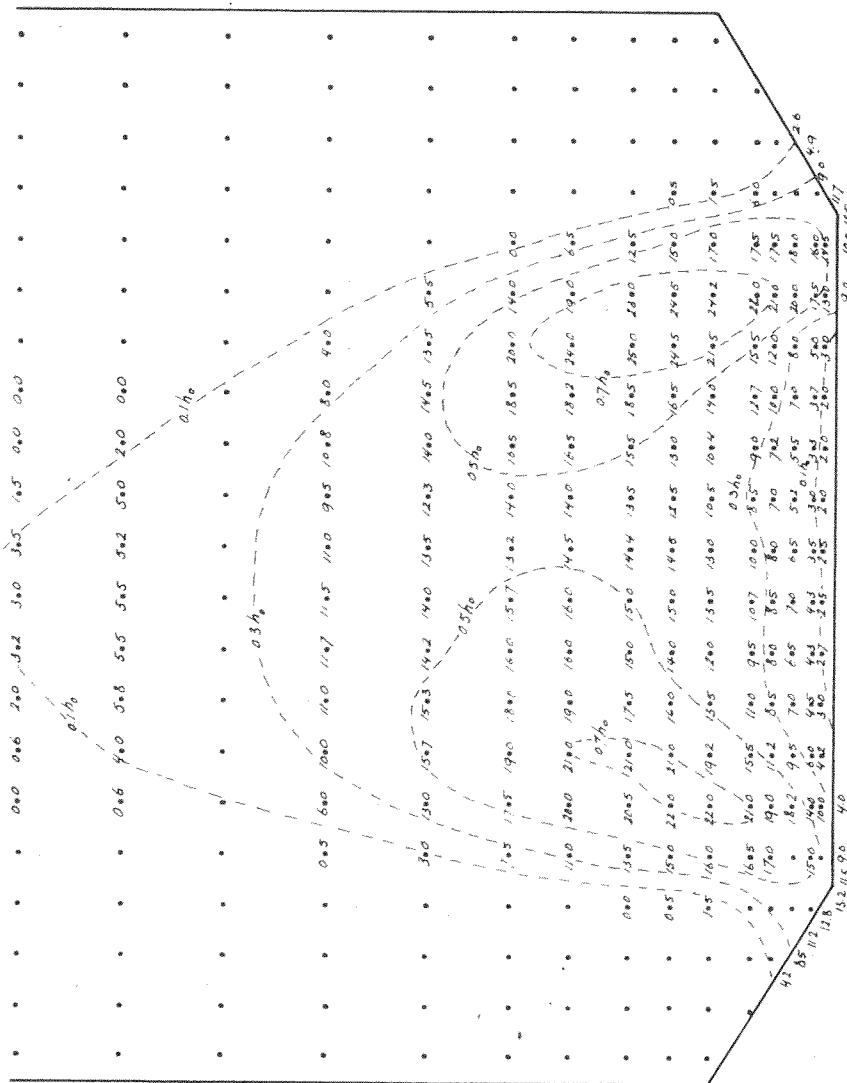
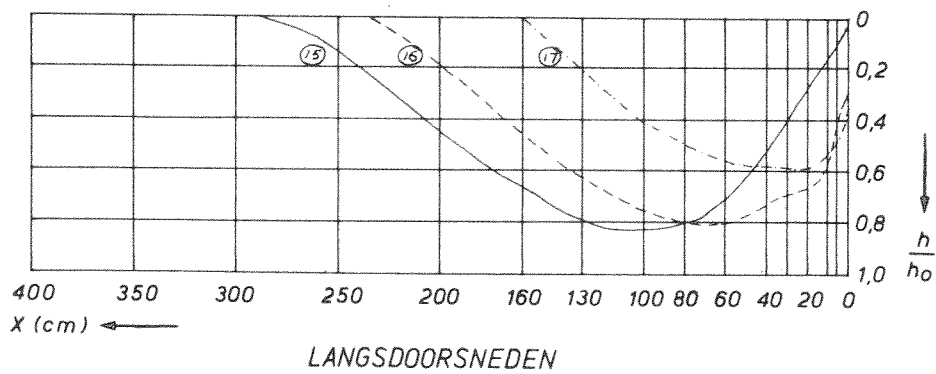
$h_0 = 30.0 \text{ cm}$

R.R.

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FIG.II-64



SITUATIE : T 8

$Q = 152 \text{ l/s}$

$t = 6.50 - 7.08$

$t/t_{1/2} = 2.25$

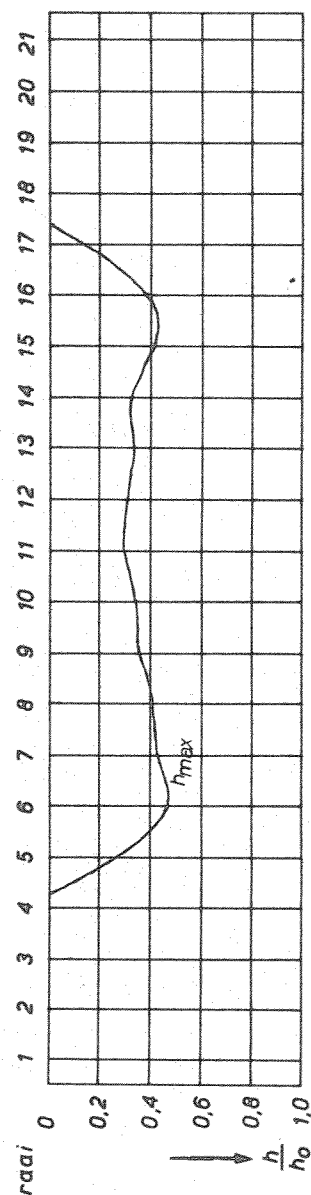
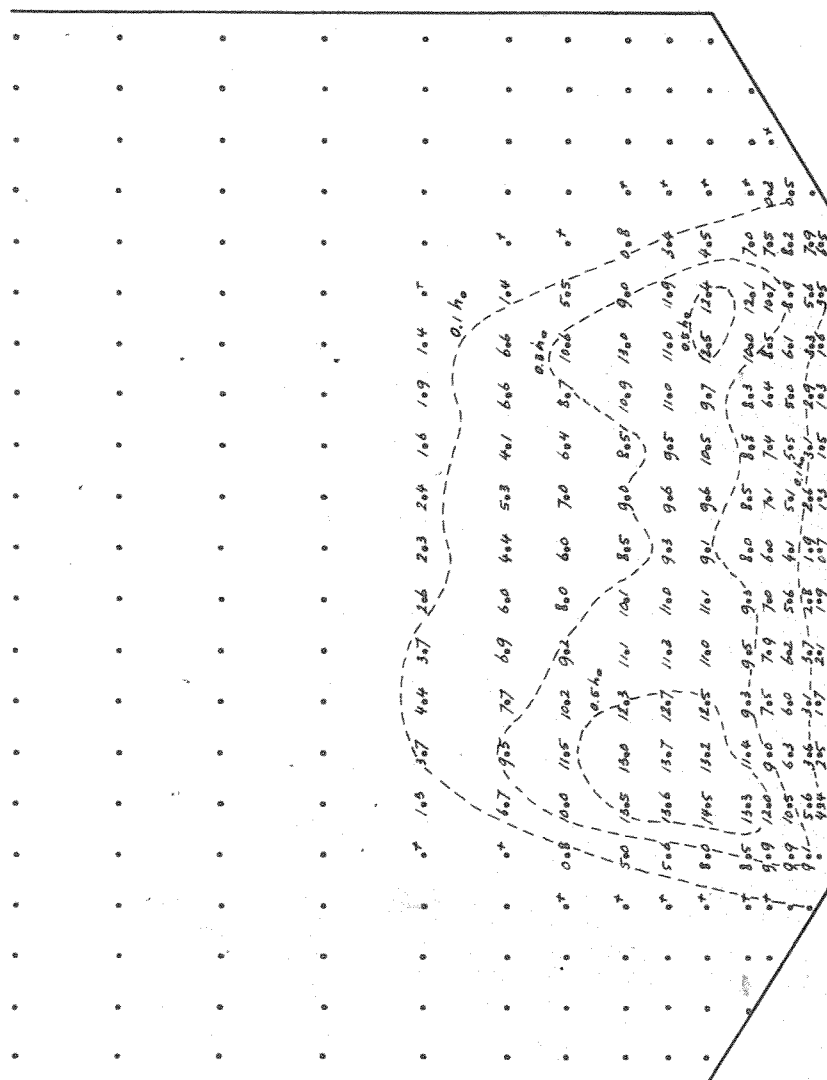
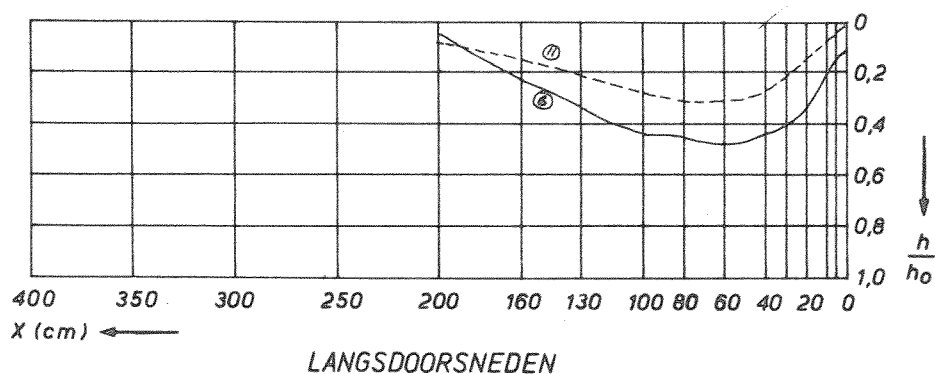
$h_0 = 30.0 \text{ cm}$

R.R.

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FIG.II-65



-SITUATIE : T 8

$Q = 203 \text{ l/s}$

$t = 0.30 - 0.40$

$t/t_{1/2} = 0.78$

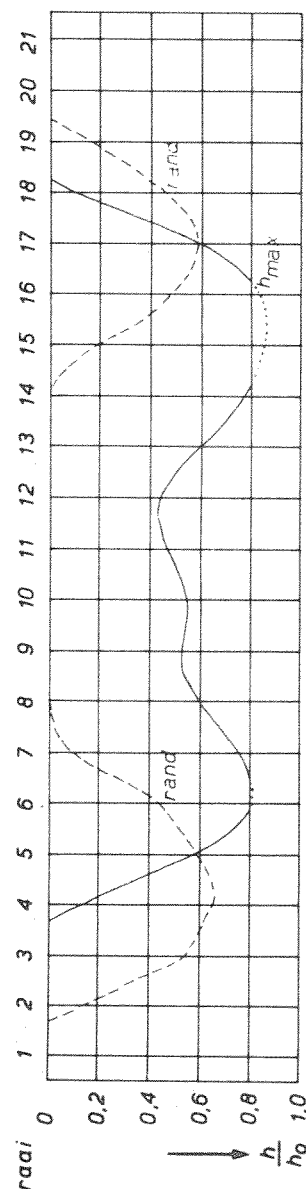
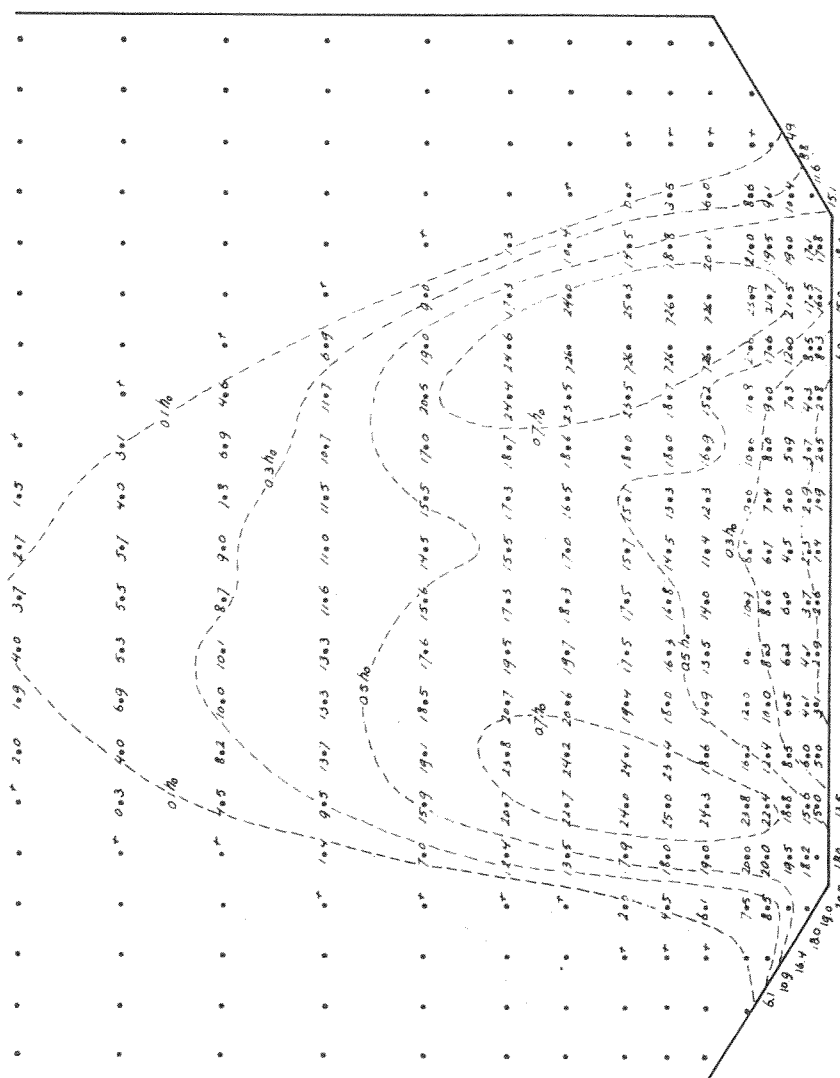
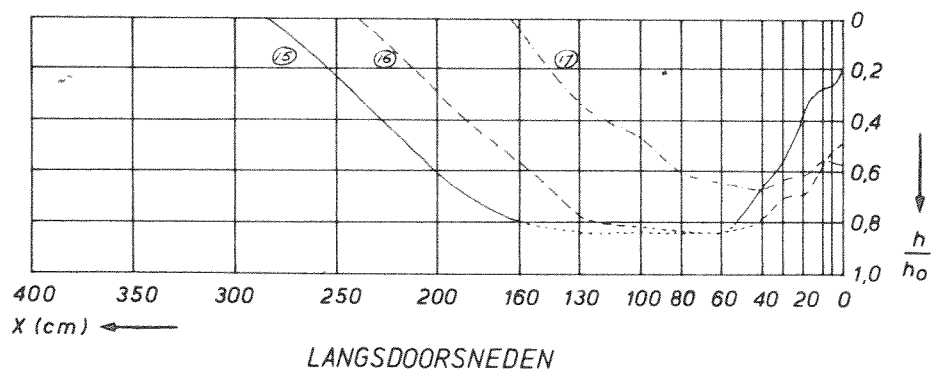
$h_0 = 30.8 \text{ cm}$

R.R.

WATERLOOPKUNDIG LABORATORIUM

M.1201 - 1107

FIG.II-66



SITUATIE : T₀

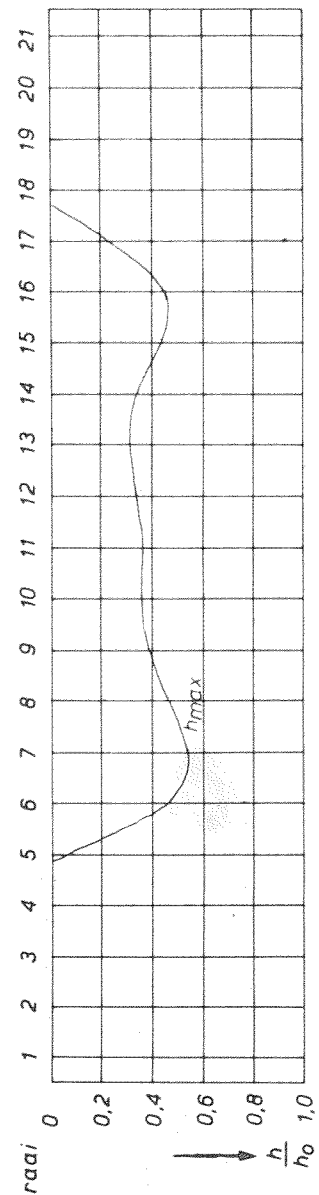
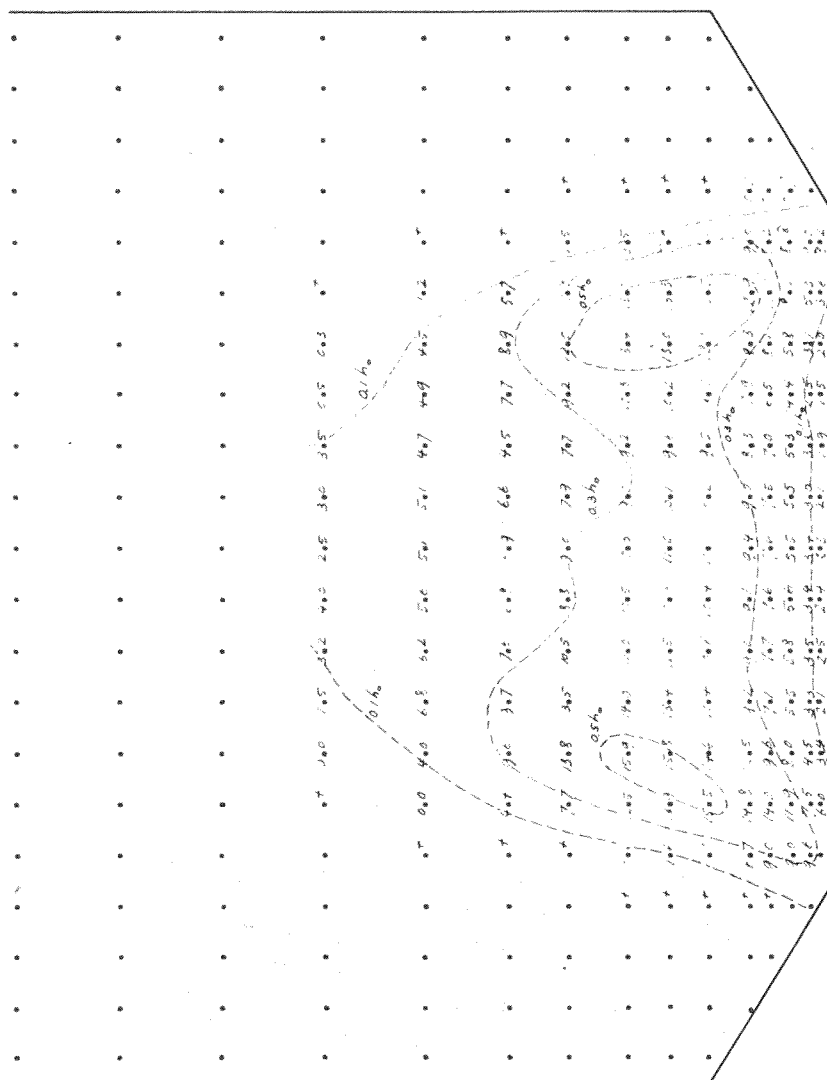
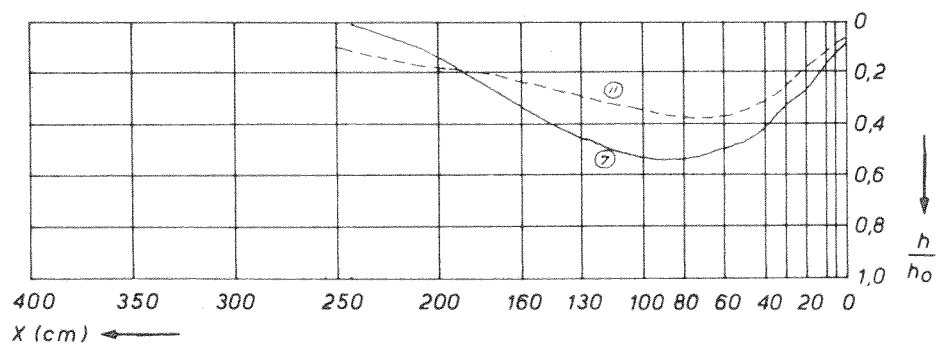
Q = 203 l/s

t = 2.00 - 2.17

$t/t_{1/2} = 2.86$

$h_0 = 30.8 \text{ cm}$

R.R.



SITUATIE : T8^A

$Q = 152 \text{ l/s}$

$t = 3.00 - 3.14$

$t/t_{1/2} = 1.0$

$h_0 = 29.8 \text{ cm}$

R.R.

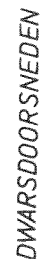
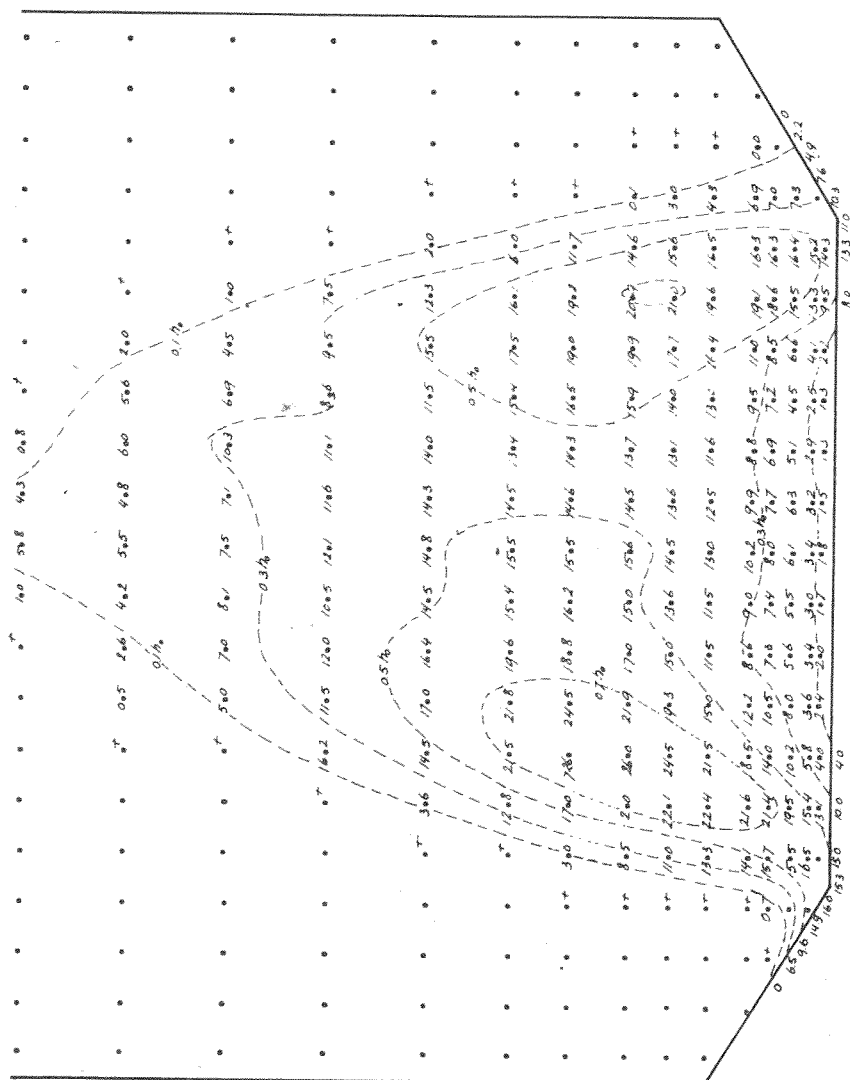


FIG. II-69

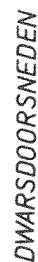
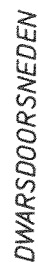
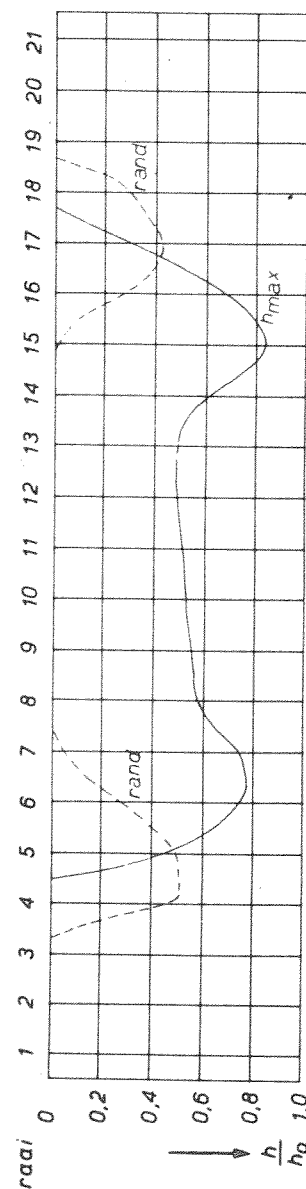
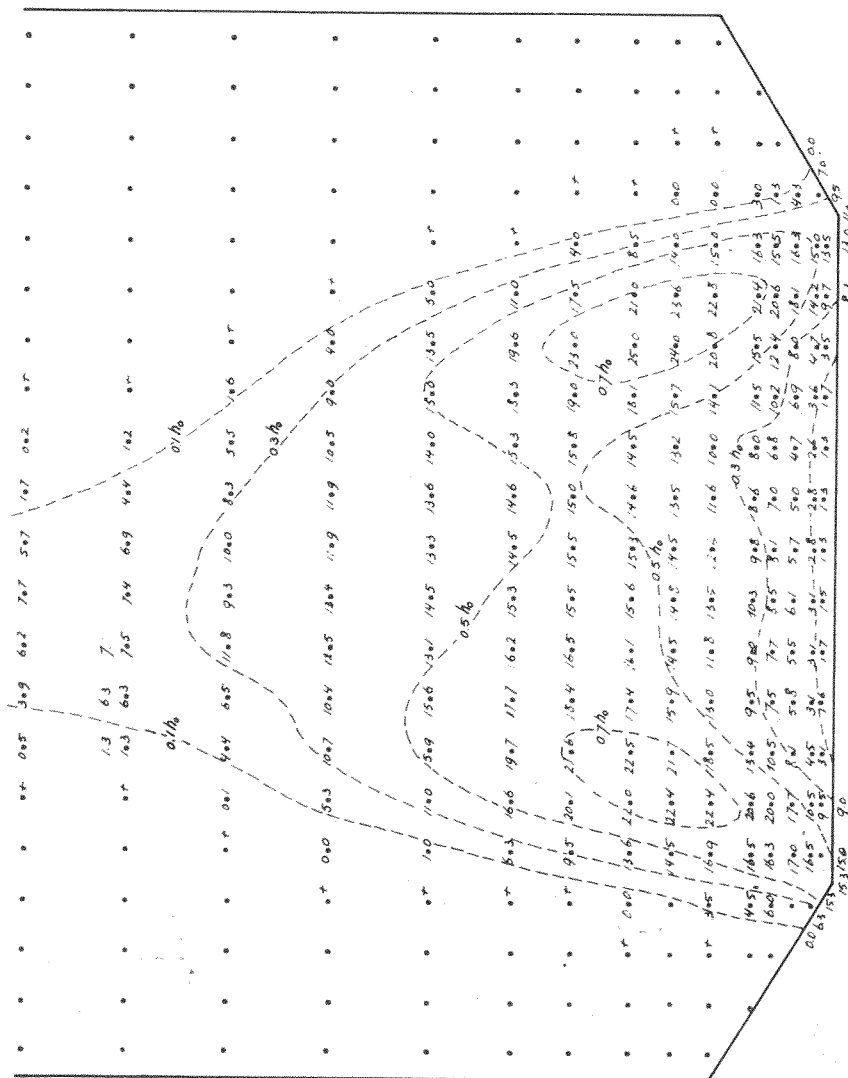
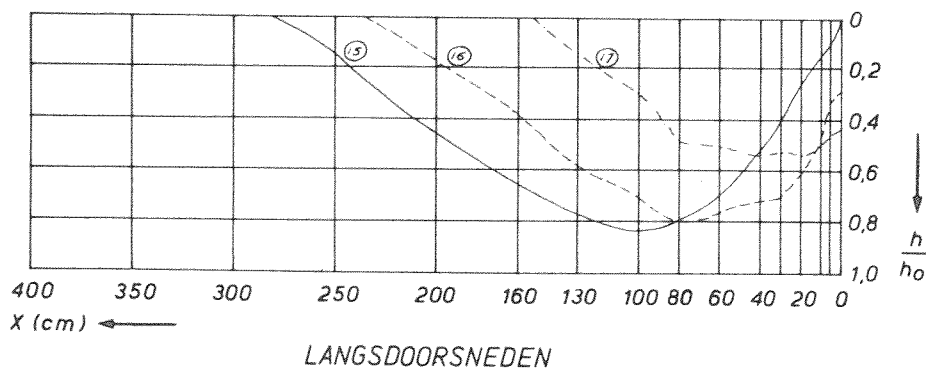


FIG. II-70



SITUATIE : T₀^B

Q = 152 l/s

t = 7.00-7.20

t/t_{1/2} = 2.31

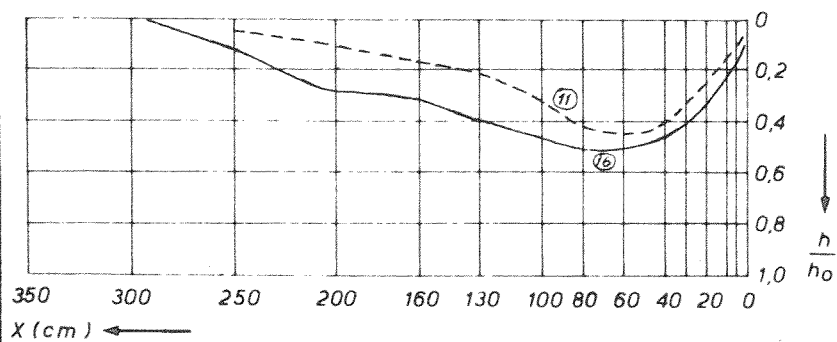
h₀ = 29.9 cm

R.R.

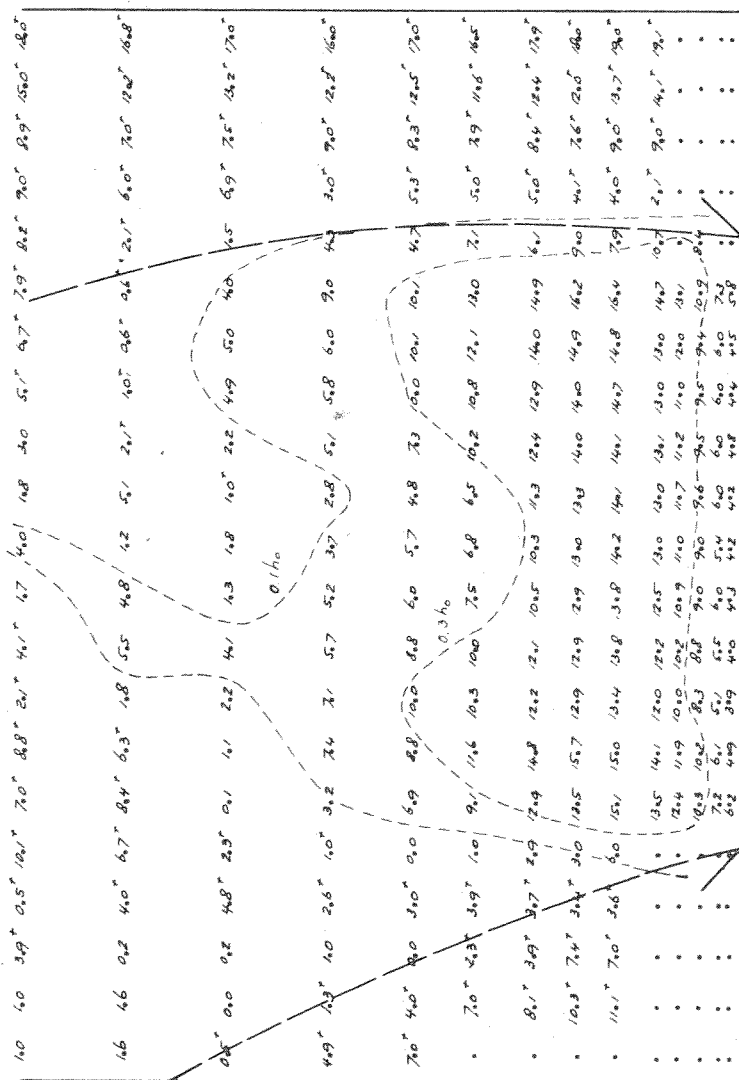
WATERLOOPKUNDIG LABORATORIUM

M.1201 - 1112

FIG.II-71



LANGSDOORSNEDEN



DWARSDOORSNEDEN

SITUATIE T 9

$Q = 120 \text{ l/s}$

$t = 22.00 - 22.16$

$t/t_{1/2} = 1.0$

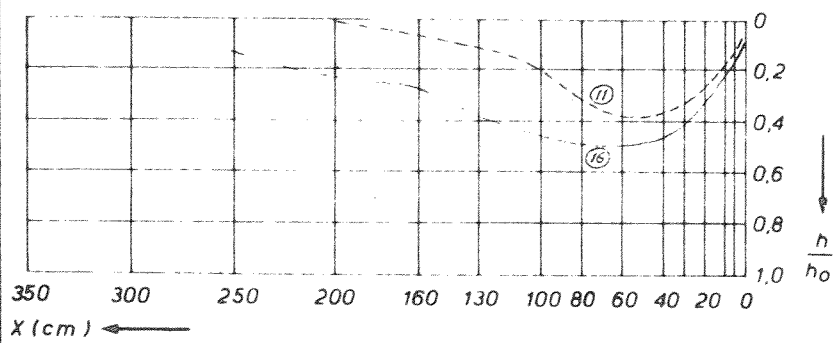
$h_0 = 32.0 \text{ cm}$

R.R.

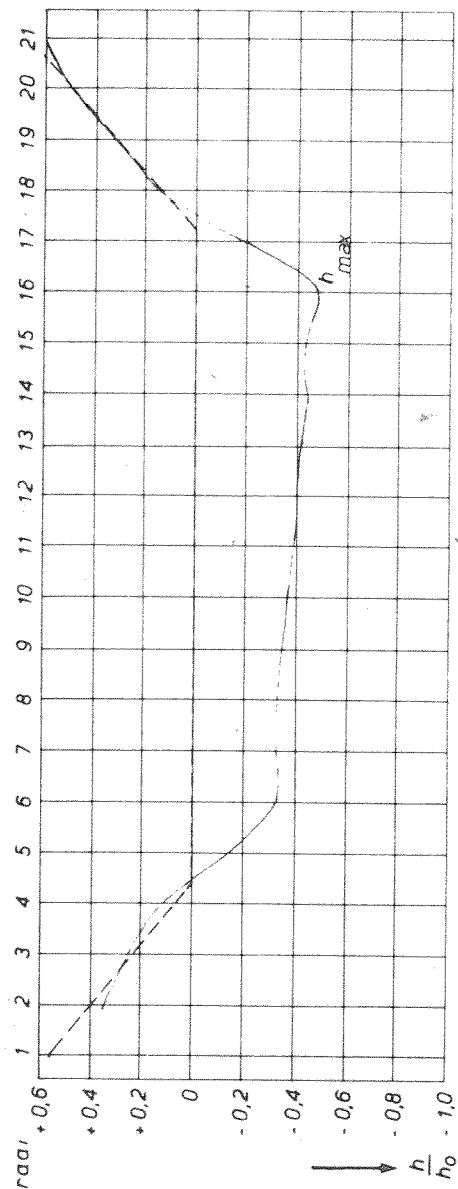
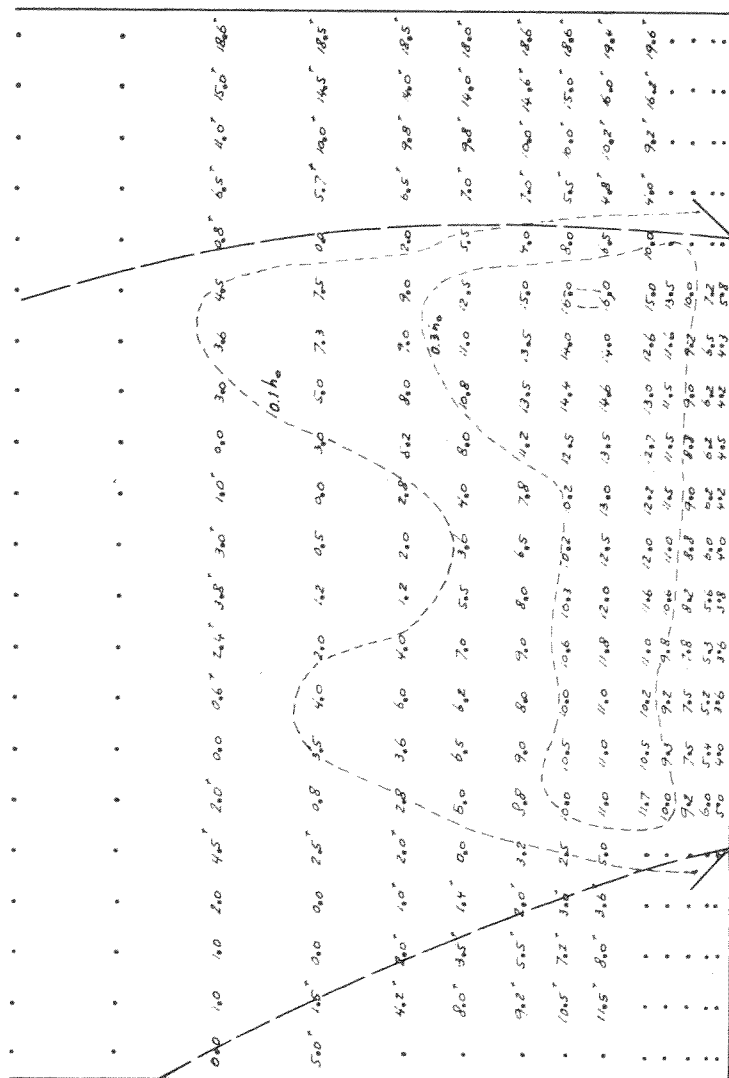
WATERLOOPKUNDIG LABORATORIUM

M.1201 - 1113

FIG.II-72



LANGSDOORSNEDEN



DWARSDOORSNEDEN

SITUATIE T 9

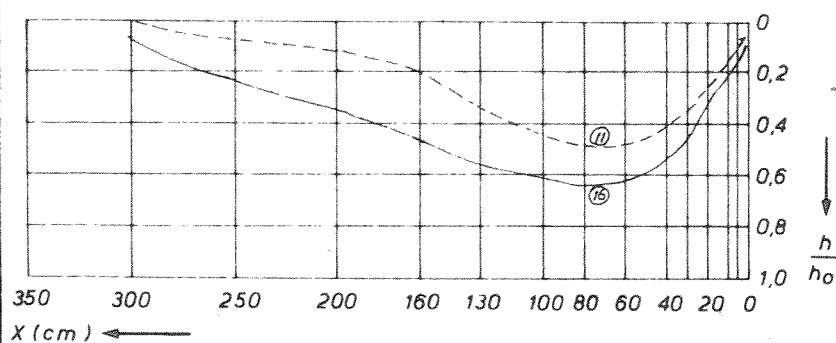
$Q = 150 \text{ l/s}$

$t = 4.00 - 4.18$

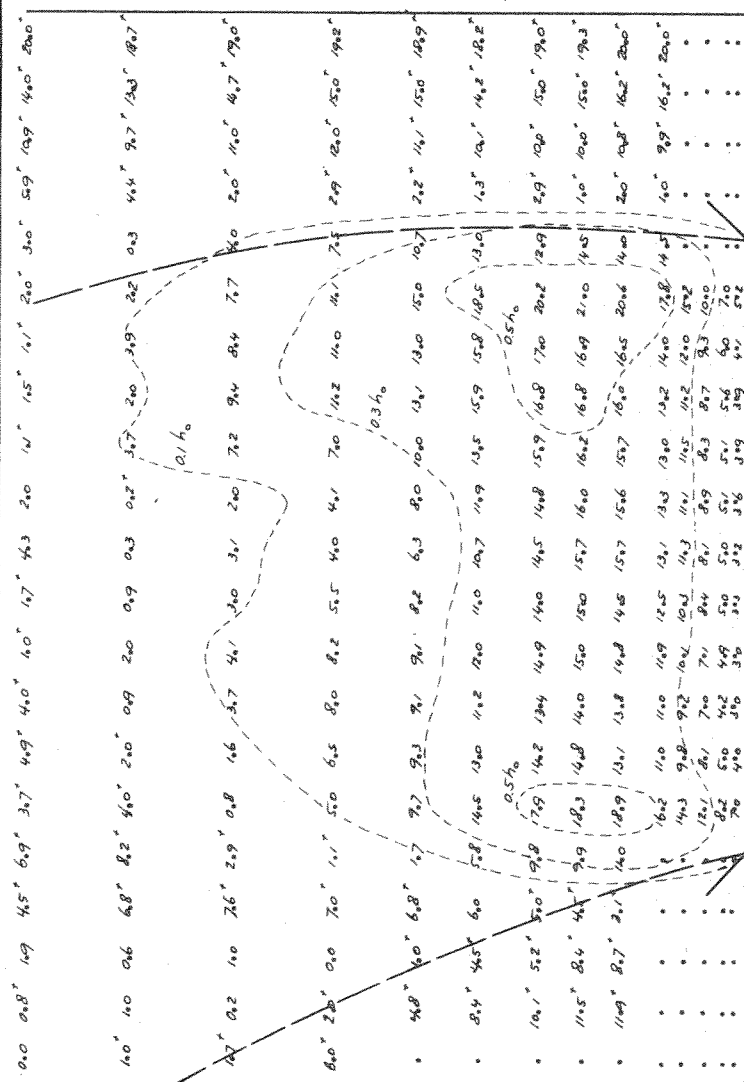
$t/t_{1/2} = 0.96$

$h_0 = 32.7 \text{ cm}$

R.R



LANGSDOORSNEDEN



DWARSDOORSNEDEN

SITUATIE . T 9

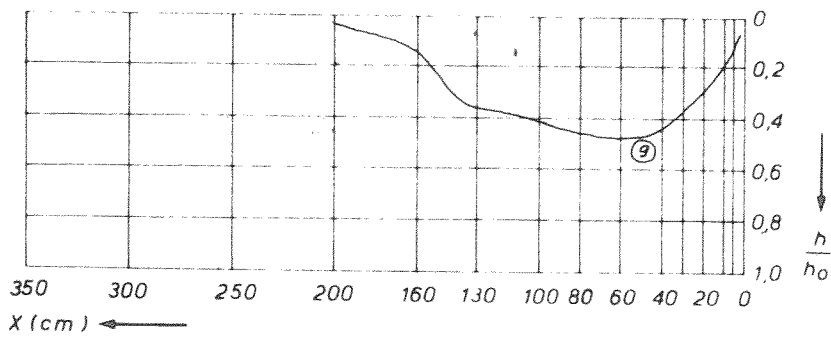
$Q = 150 \text{ l/s}$

$t = 10.00 - 10.18$

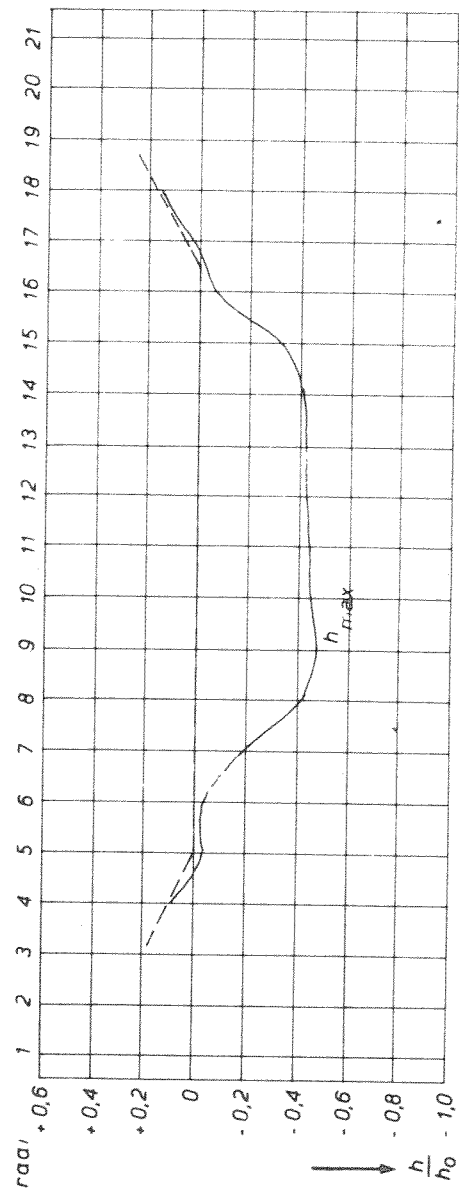
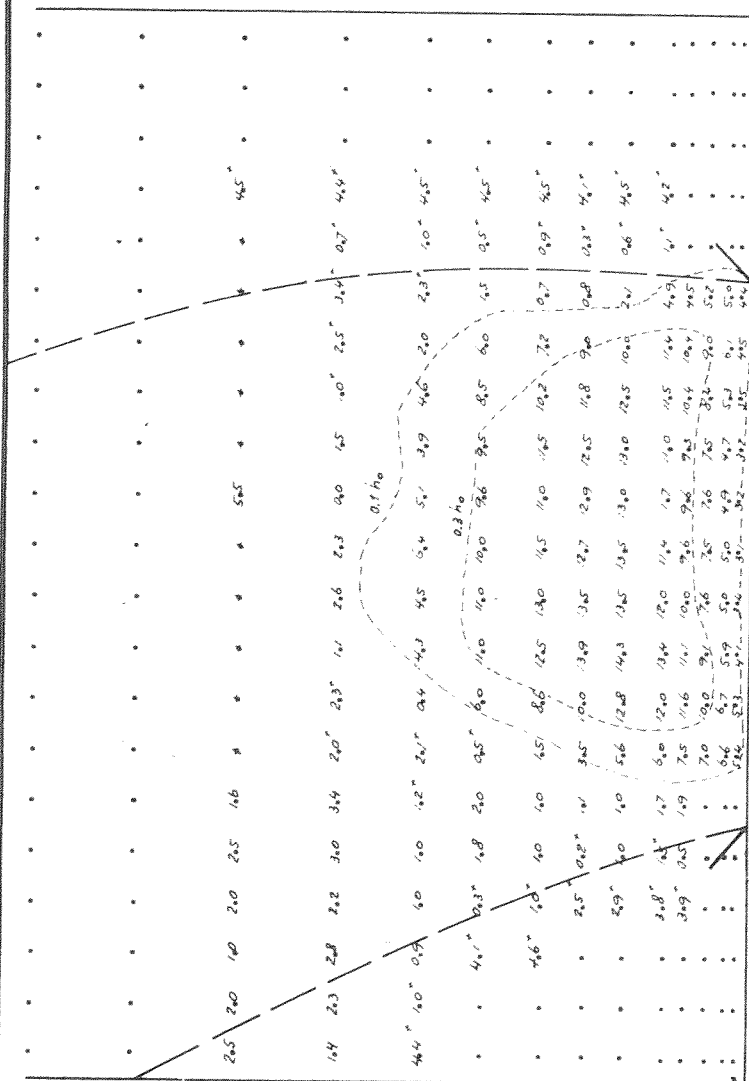
$t/t^{1/2} = 2.35$

$h_0 = 32.7 \text{ cm}$

R.R.



LANGSDOORSNEDEN



DWARSDOORSNEDEN

SITUATIE T 10

$Q = 100 \text{ l/s}$

$t = 8.00 - 8.14$

$t/t_{1/2} = 0.92$

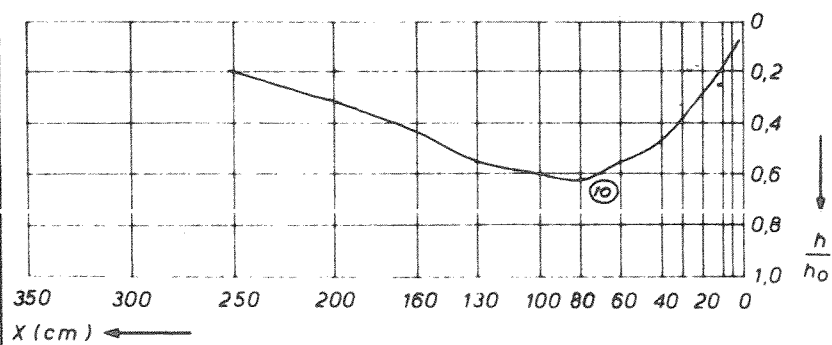
$h_0 = 30.0 \text{ cm}$

R.R.

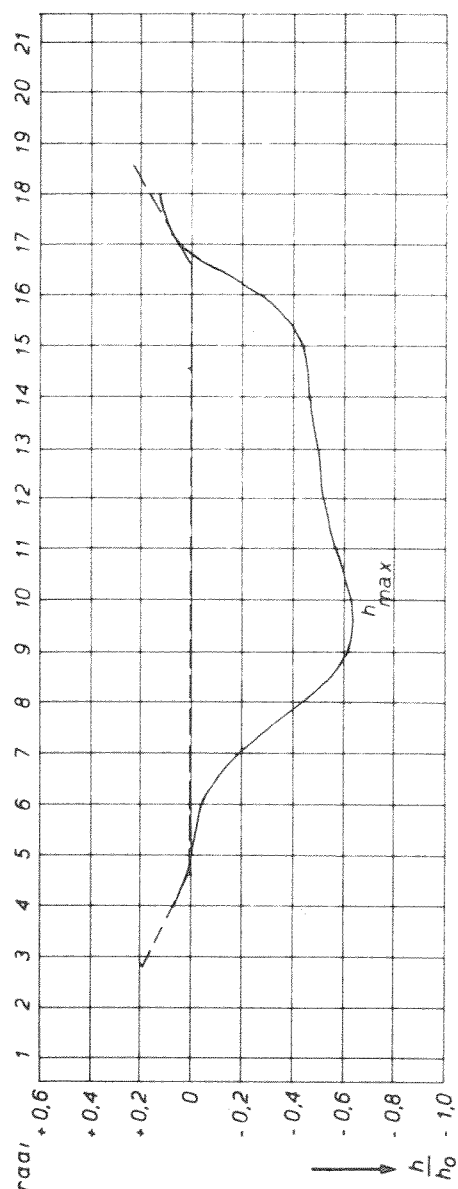
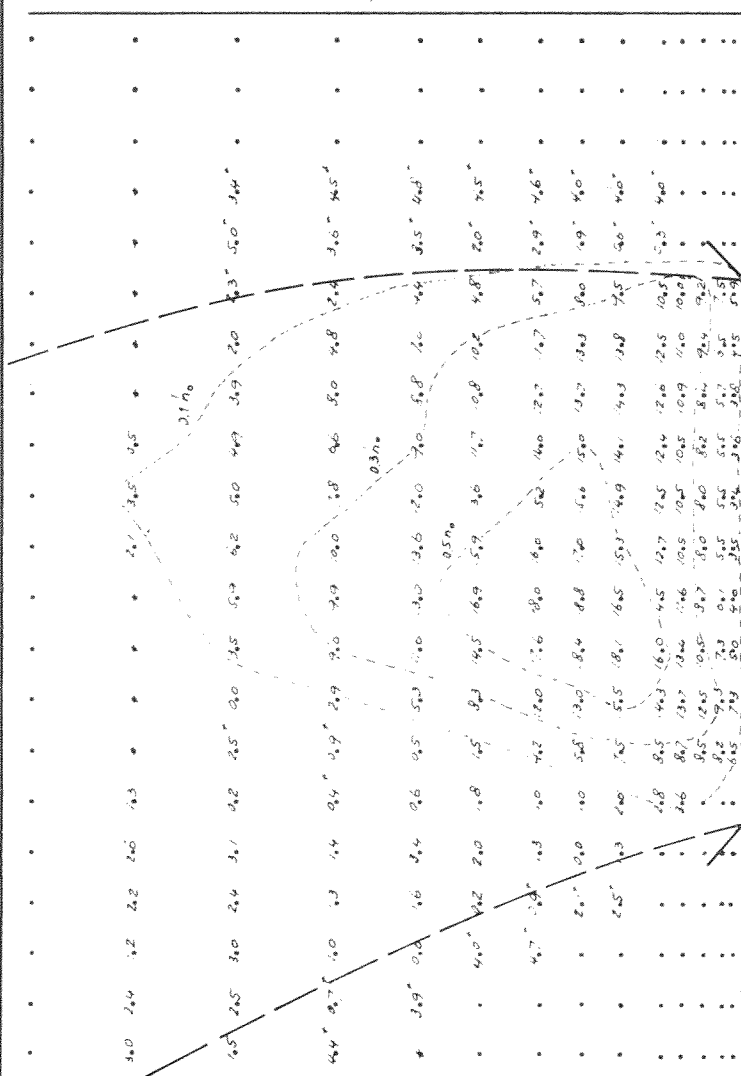
WATERLOOPKUNDIG LABORATORIUM

M 1201 - 1116

FIG.II-75



LANGSDOORSNEDEN



DWARSDOORSNEDEN

SITUATIE T 10

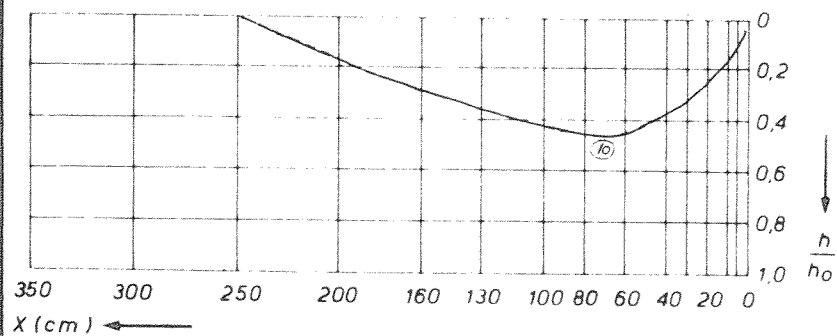
$Q = 100 \text{ l/s}$

$t = 13.00 - 13.16$

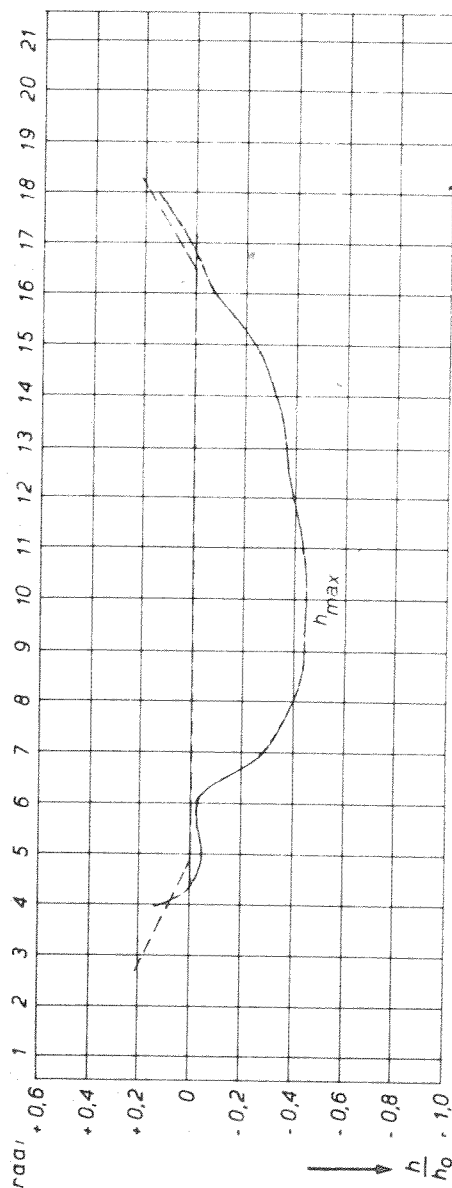
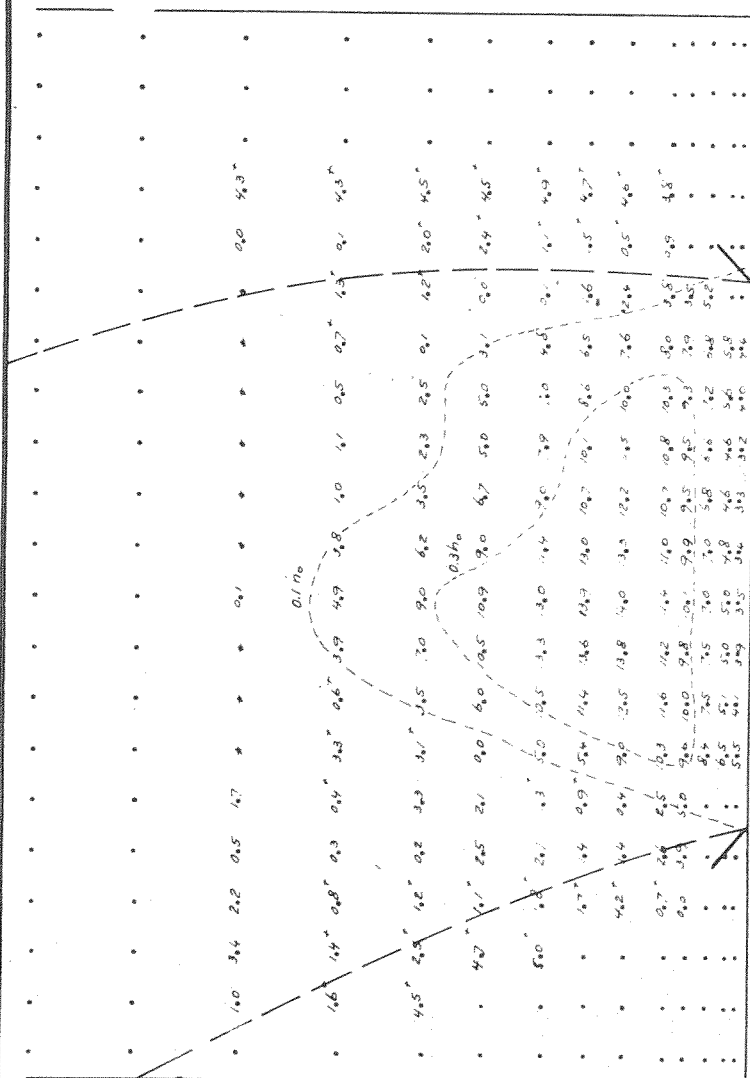
$t/t_{1/2} = 1.49$

$h_0 = 300 \text{ cm}$

RR



LANGSDOORSNEDEN



DWARSDOORSNEDEN

SITUATIE T 10

$Q = 150 \text{ l/s}$

$t = 0.30 - 0.40$

$t/t_{1/2} = 0.73$

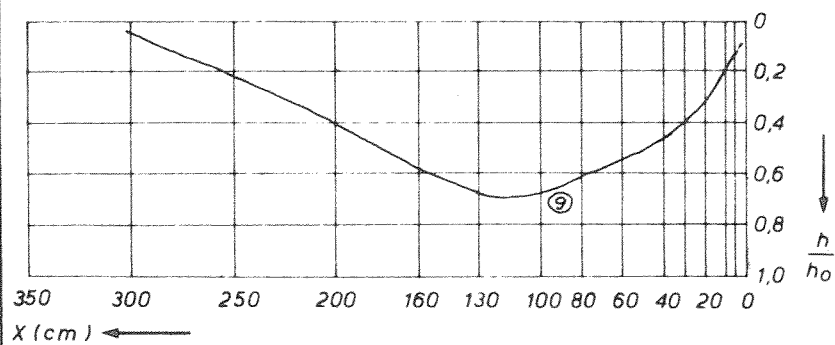
$h_0 = 309 \text{ cm}$

RR

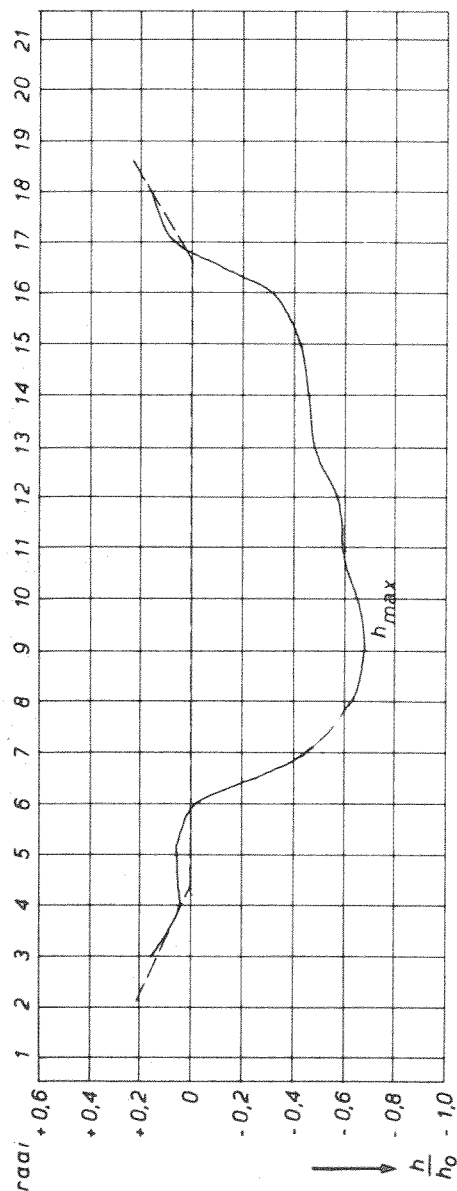
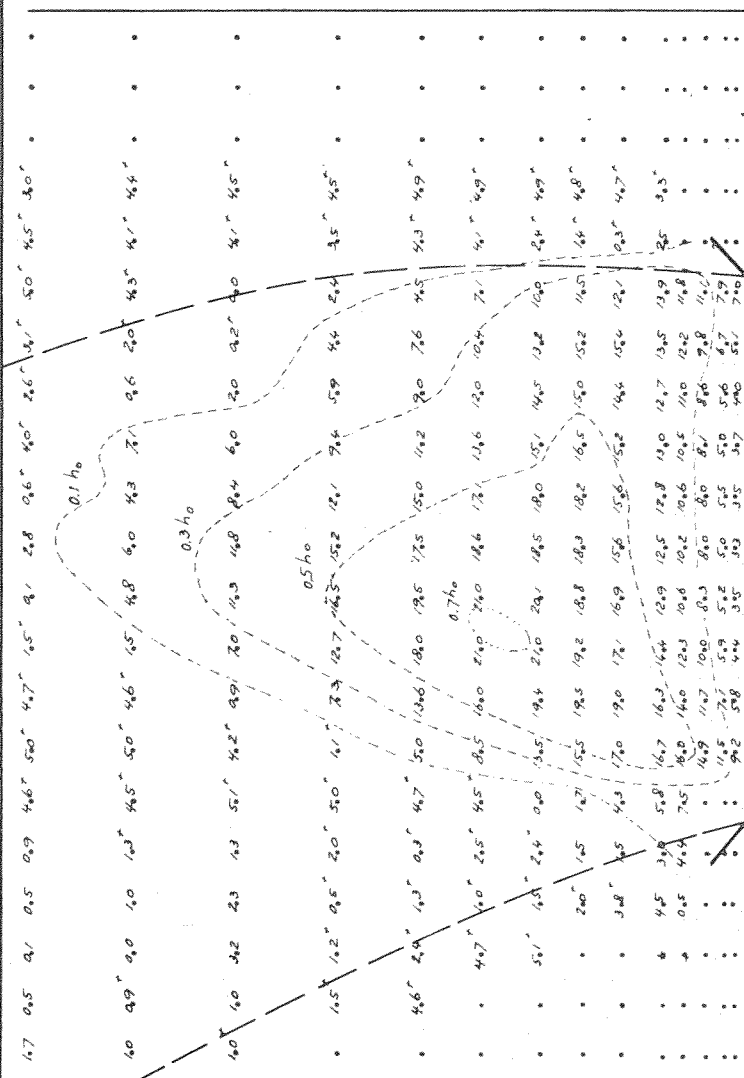
WATERLOOPKUNDIG LABORATORIUM

M.1201 - 1118

FIG. II-77



LANGSDOORSNEDEN



DWARSDOORSNEDEN

SITUATIE T 10

$Q = 150 \text{ l/s}$

$t = 1.30 - 1.52$

$t/t_{1/2} = 2.12$

$h_0 = 30.9 \text{ cm}$

R.R.

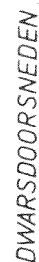
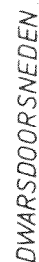
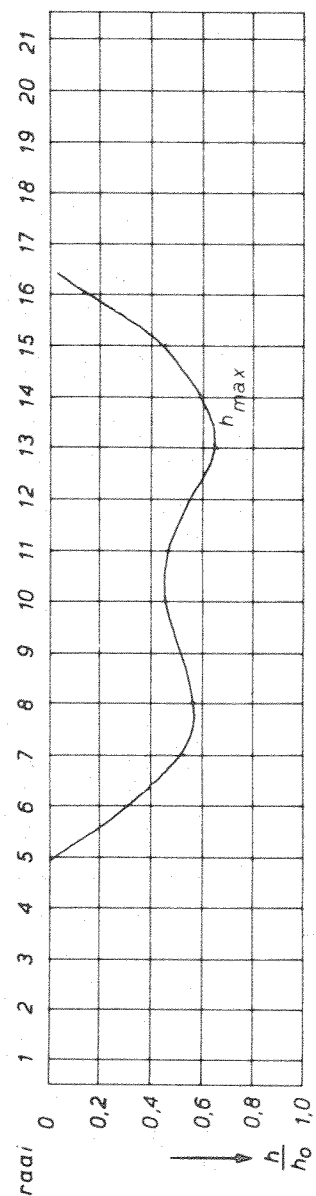
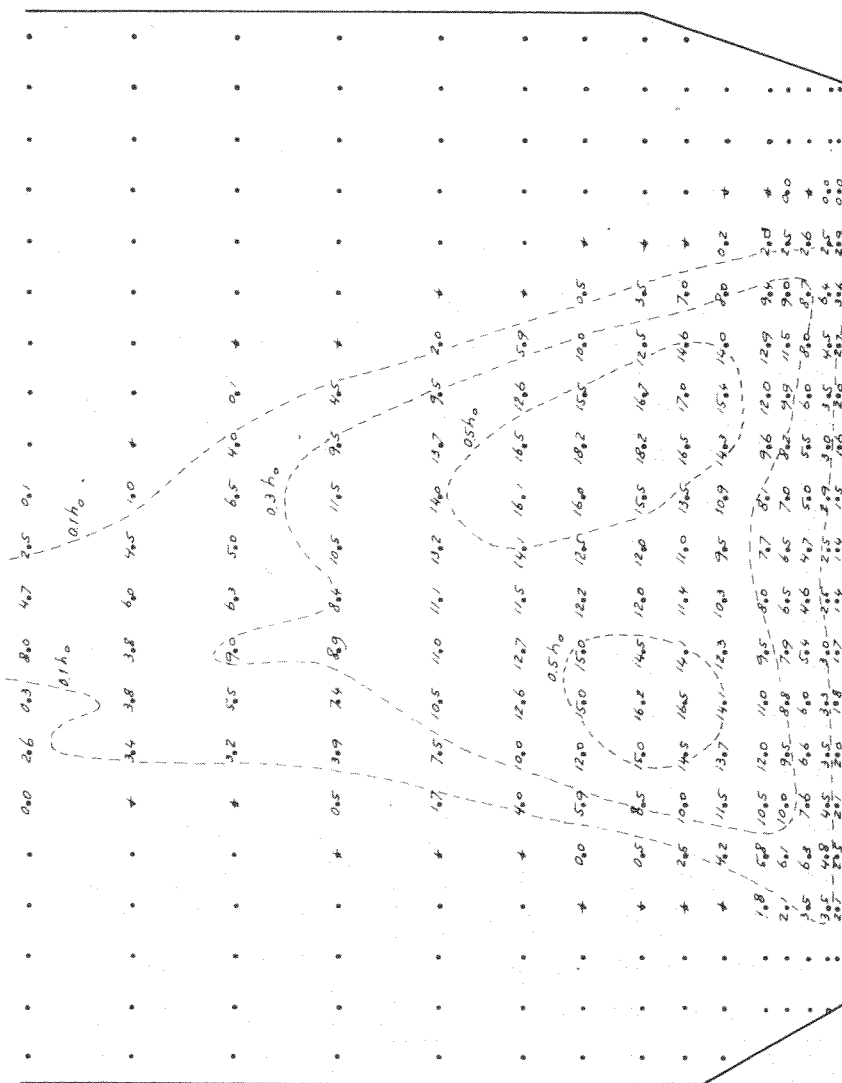
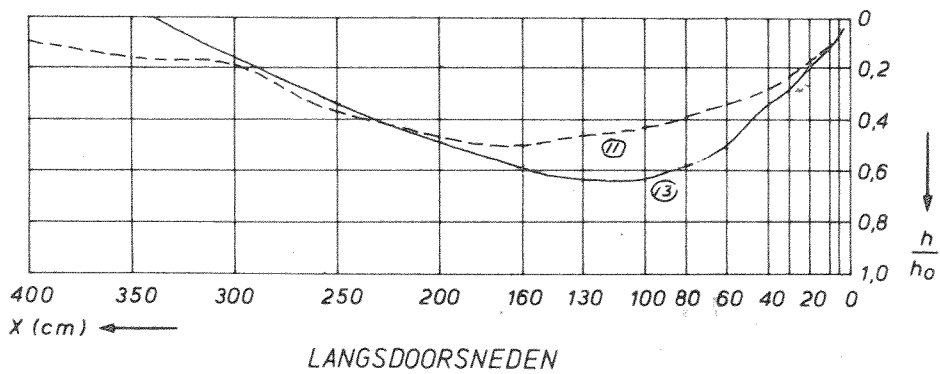


FIG. II-79



SITUATIE : T 11

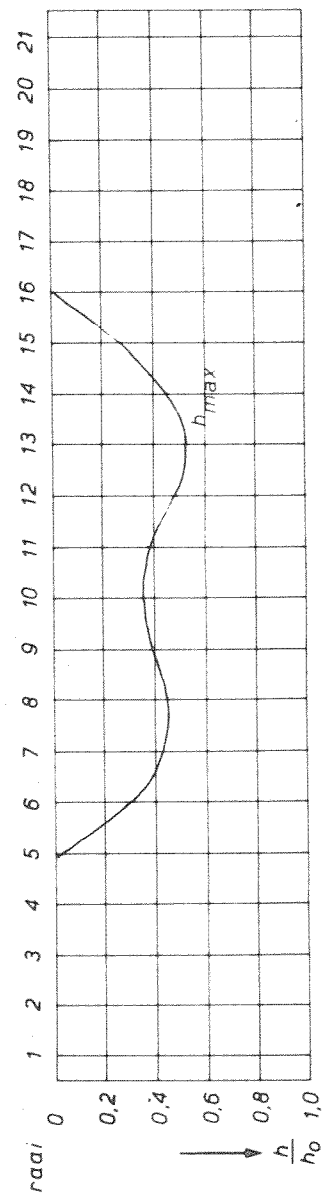
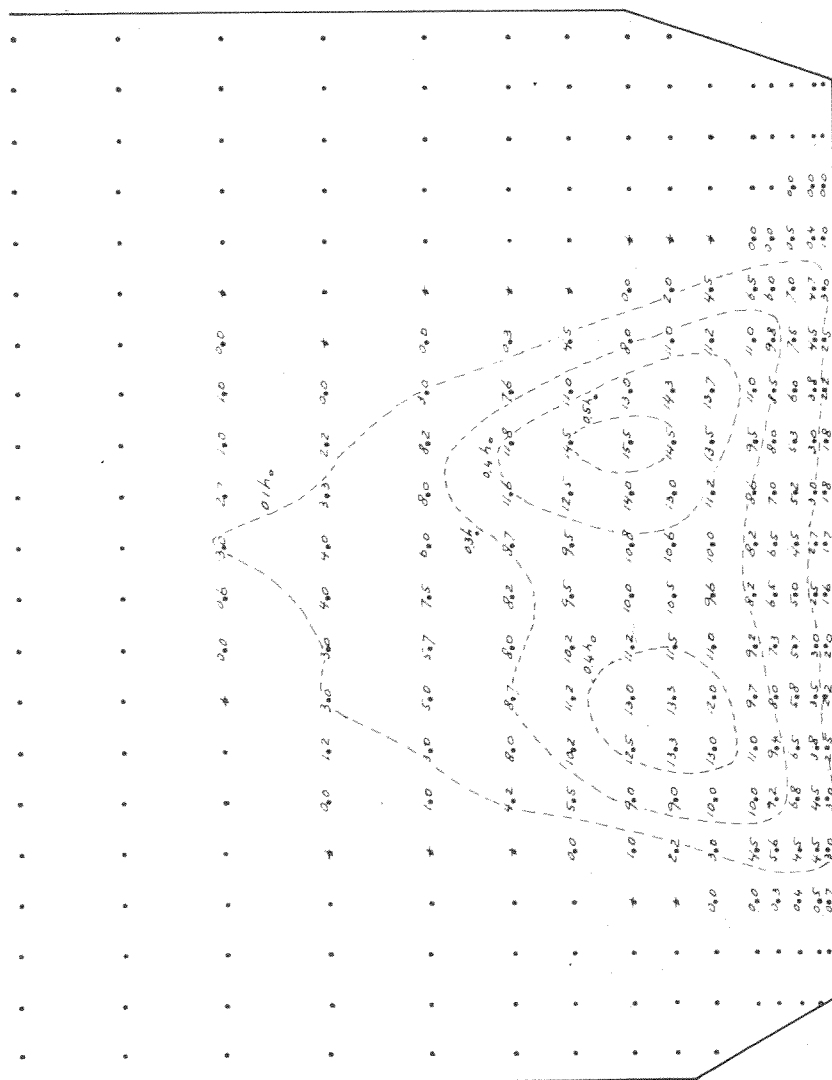
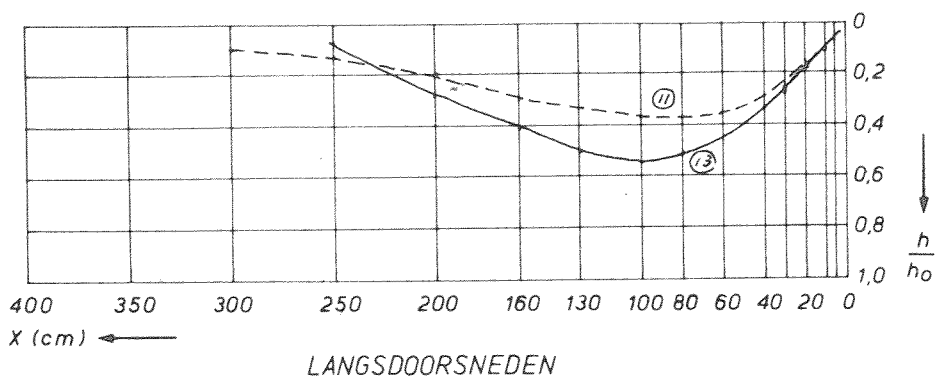
$Q = 120 \text{ l/s}$

$t = 12.00 - 12.19$

$t/t_{1/2} = 1.74$

$h_0 = 28.1 \text{ cm}$

R.R.



SITUATIE : T 11

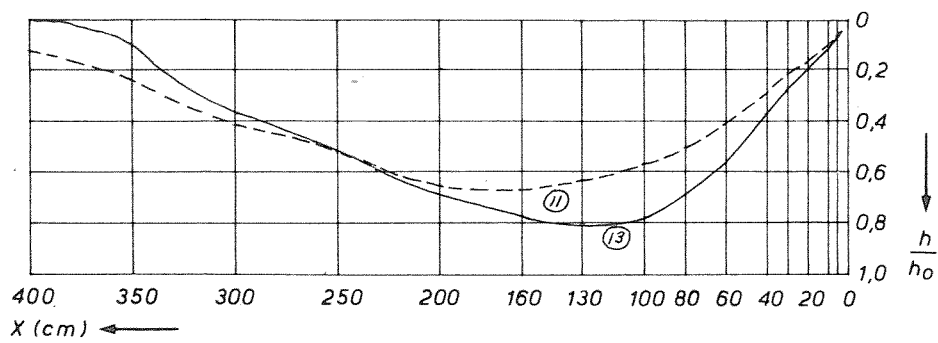
$Q = 150 \text{ l/s}$

$t = 2.00 - 2.14$

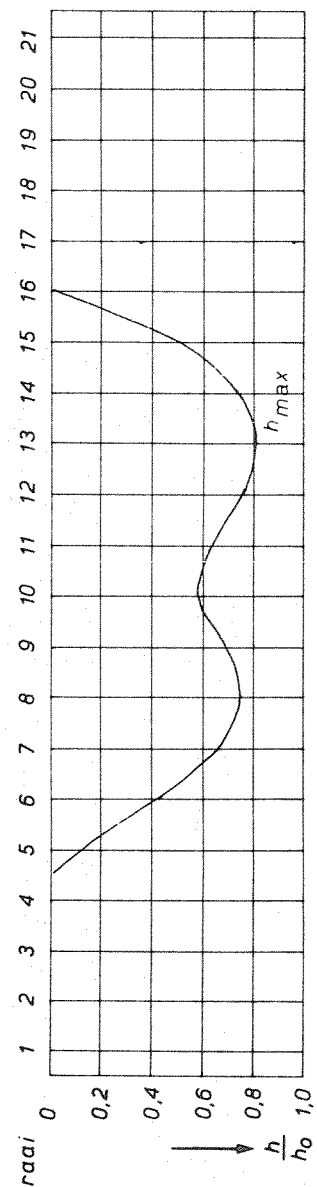
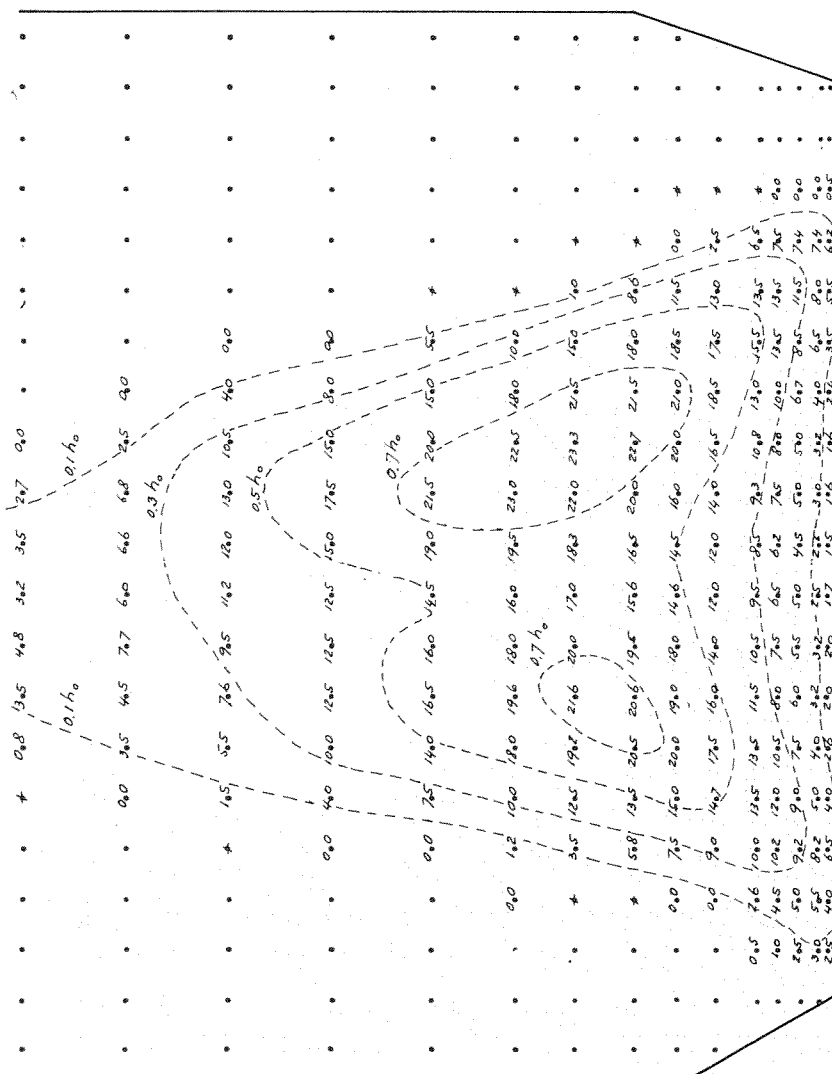
$t/t_{1/2} = 1.0$

$h_0 = 28.9 \text{ cm}$

R.R.



LANGSDOORSNEDEN



DWARSDOORSNEDEN

SITUATIE : T 11

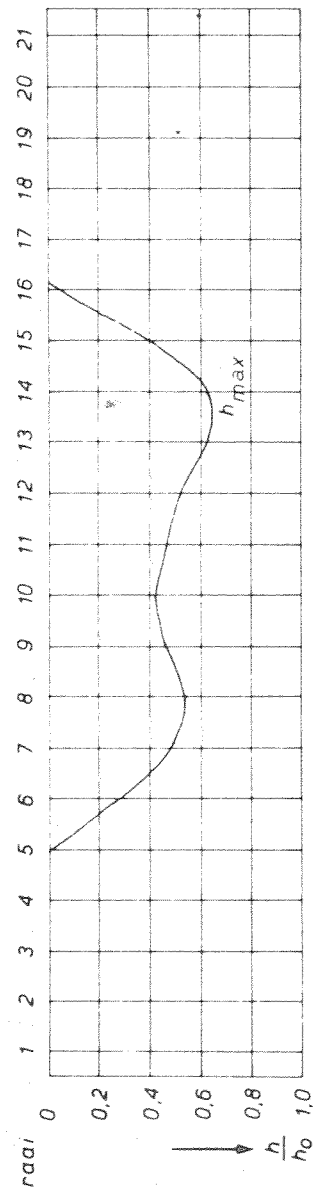
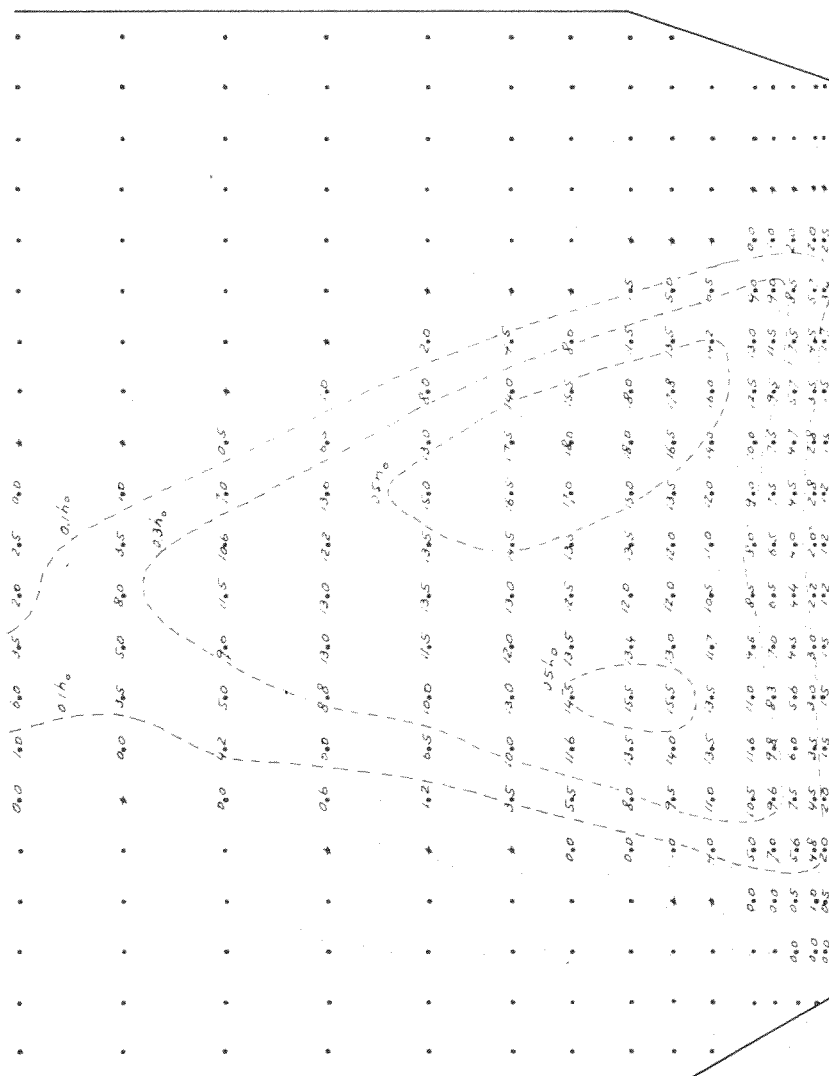
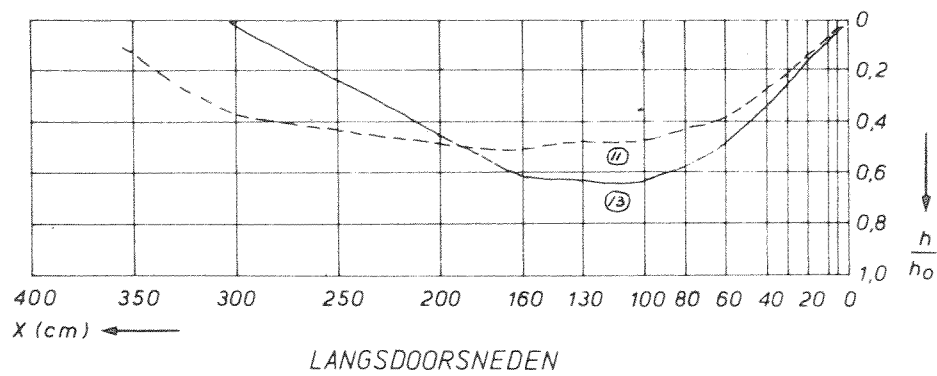
$Q = 150 \text{ l/s}$

$t = 5.00 - 5.22$

$t/t_{1/2} = 2.47$

$h_0 = 28.9 \text{ cm}$

R.R.



SITUATIE : T 12

$Q = 120 \text{ l/s}$

$t = 12.00 - 12.17$

$t/t_{1/2} = 1.35$

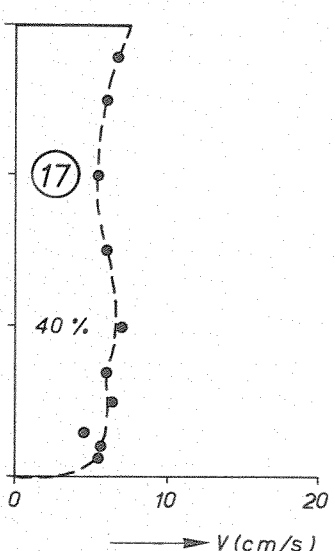
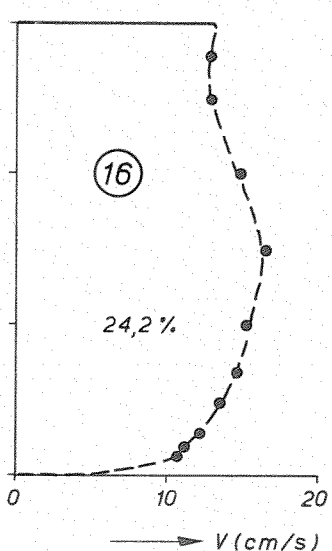
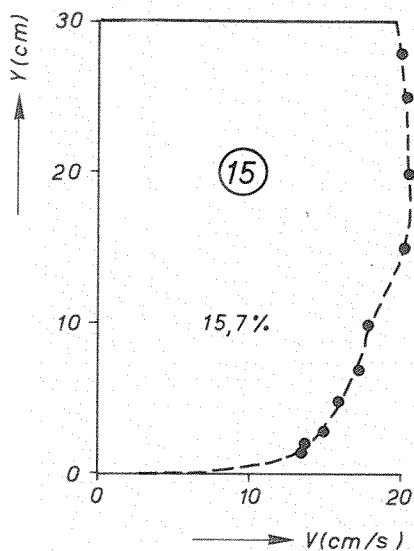
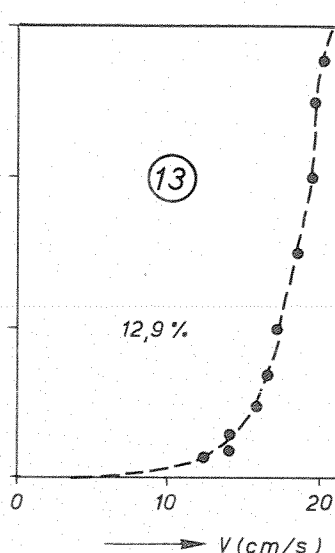
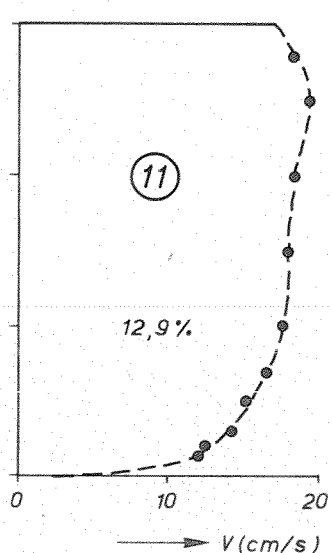
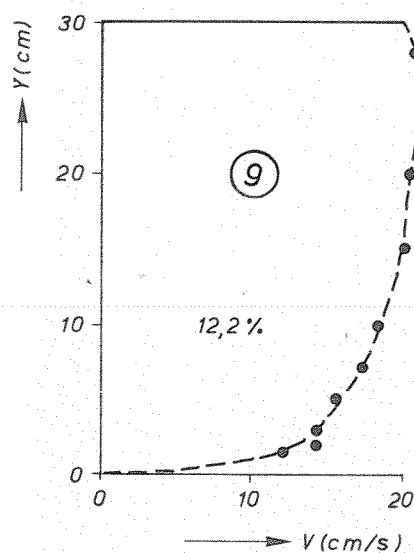
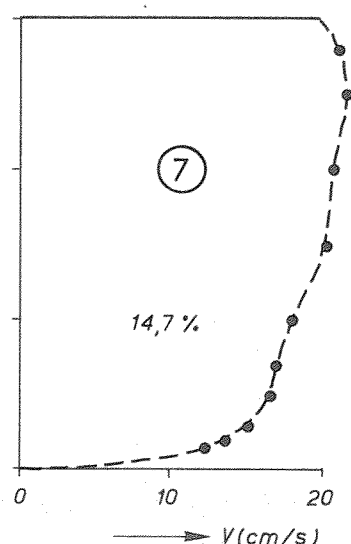
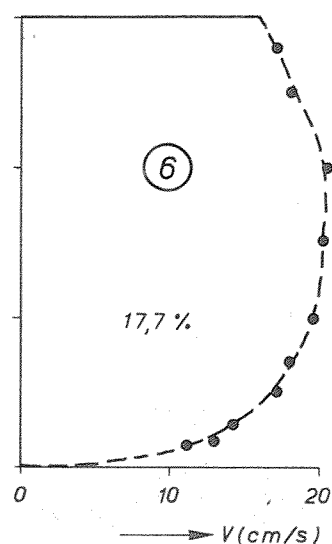
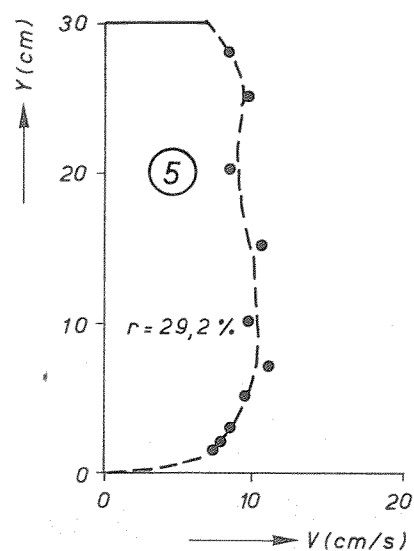
$h_0 = 28.3 \text{ cm}$

R.R.

WATERLOOPKUNDIG LABORATORIUM

M.1201 - 1125

FIG. II-84



SNELHEIDSVERDELINGEN $Q=152$ l/s

$T_1 - 152$

WK

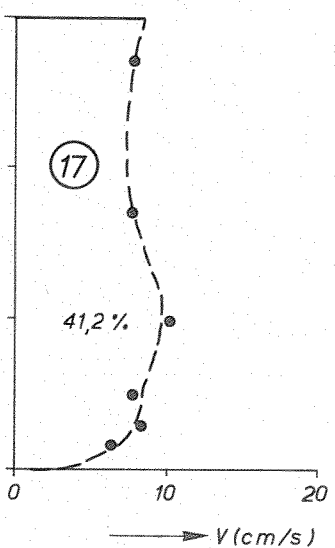
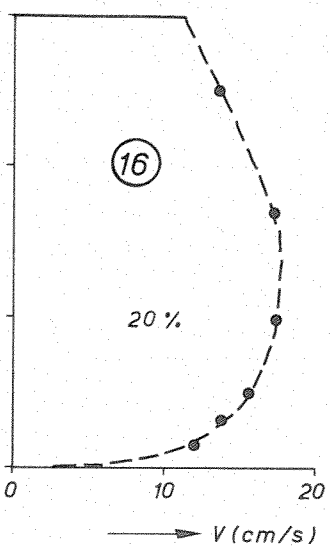
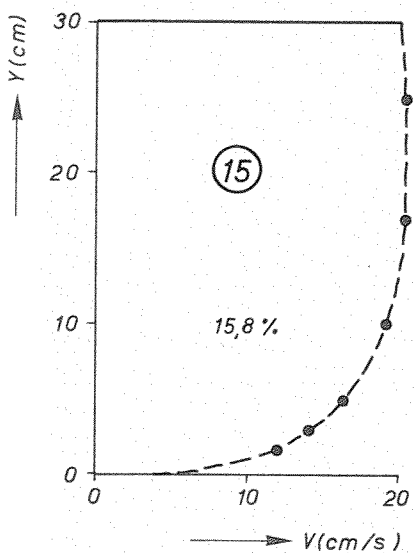
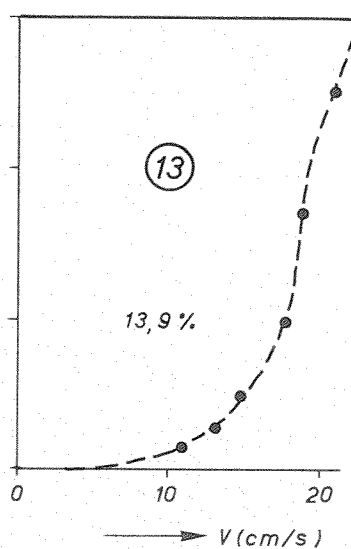
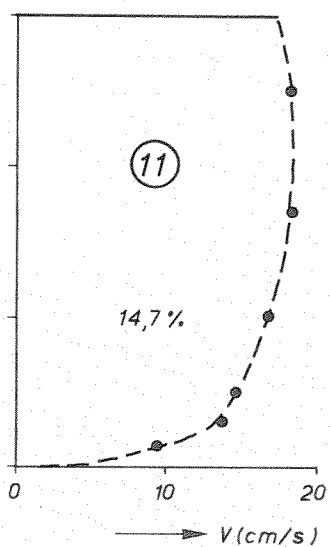
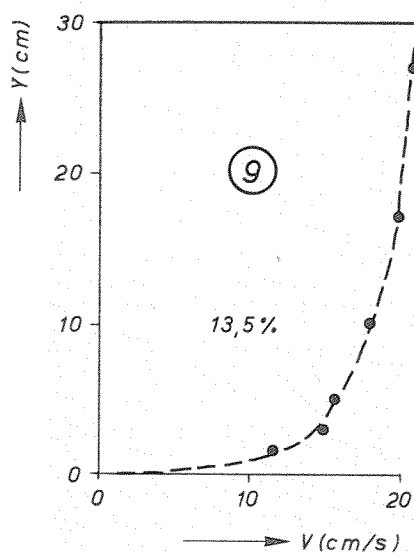
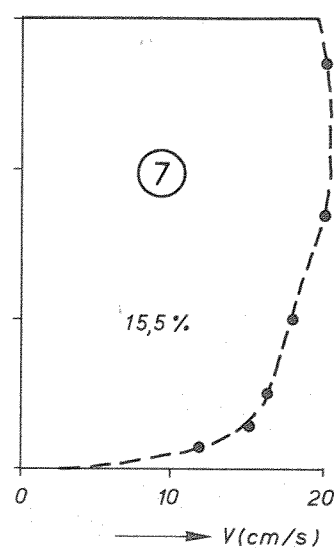
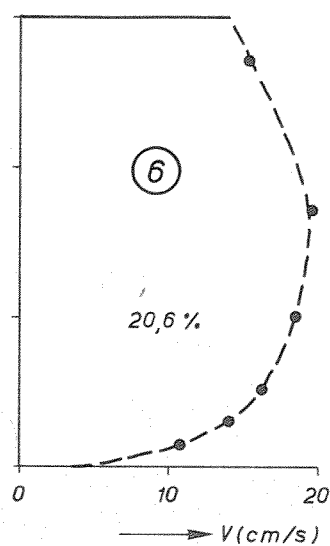
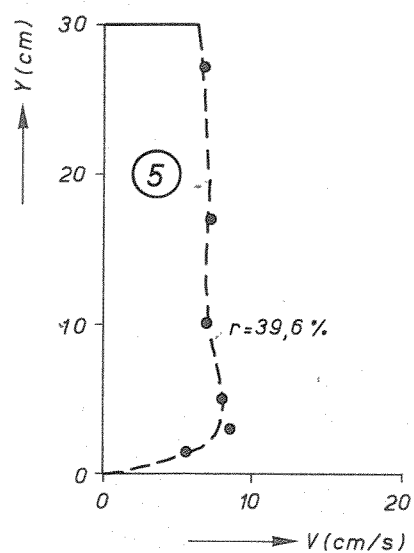
$h_0 = 29,9$ cm

A4

WATERLOOPKUNDIG LABORATORIUM

M.1201 - 1034

FIG. II - 85



SNELHEIDSVERDELINGEN $Q=152$ l/s

T_1^R-152

WK

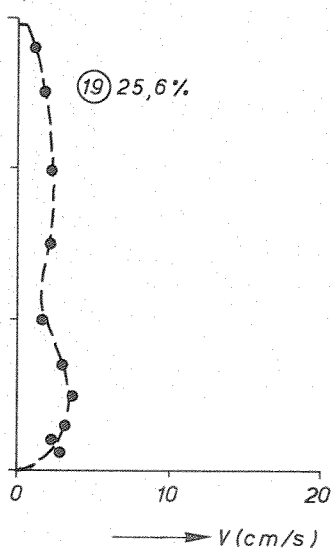
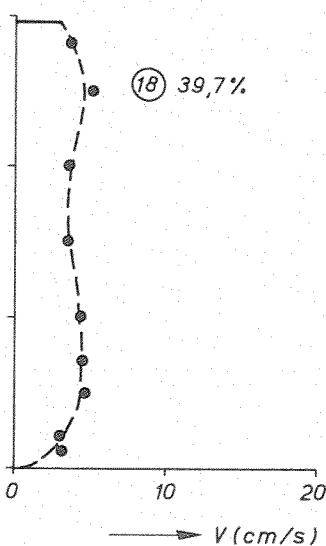
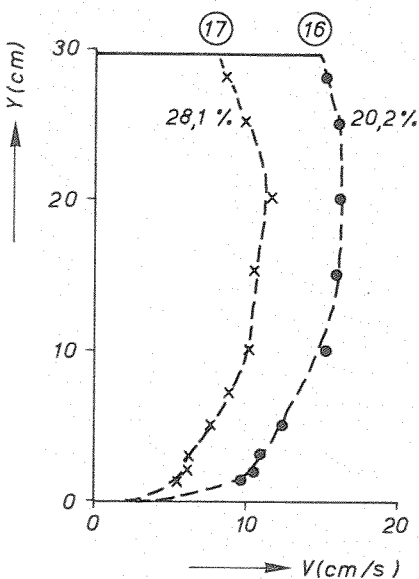
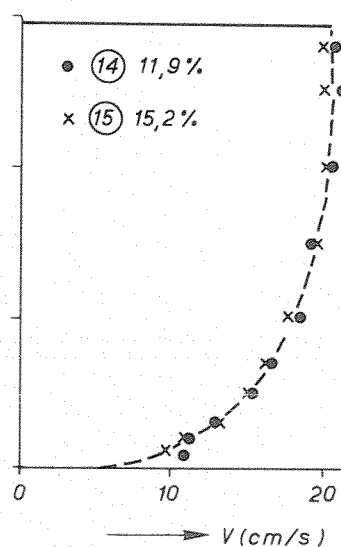
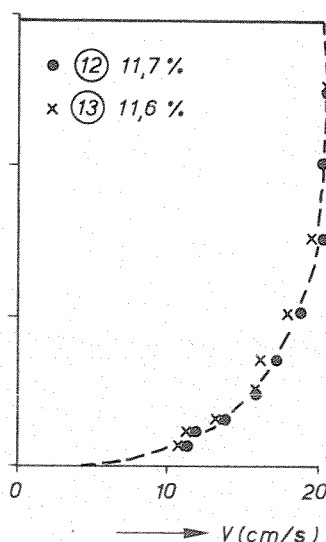
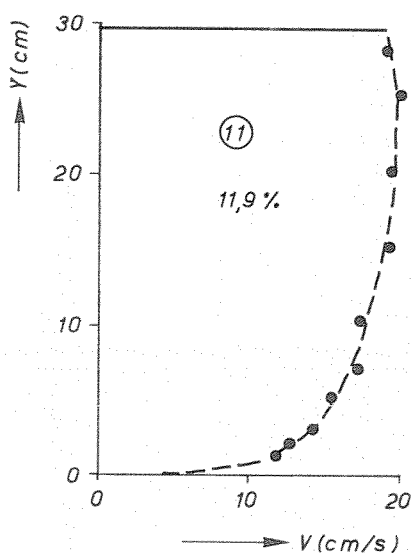
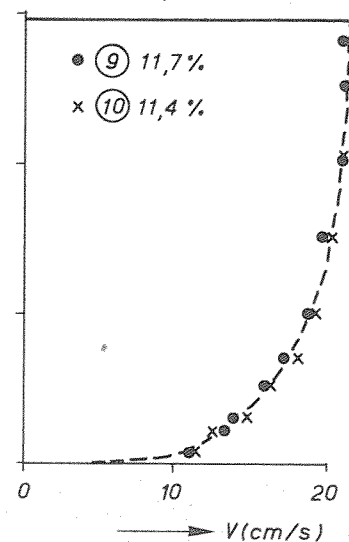
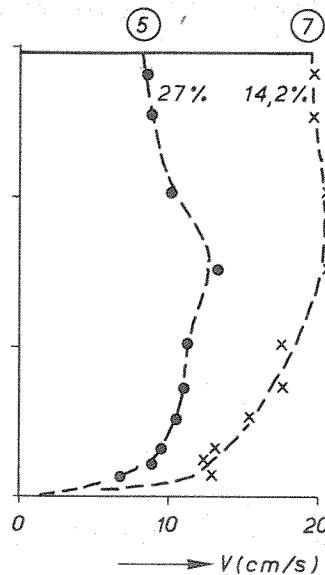
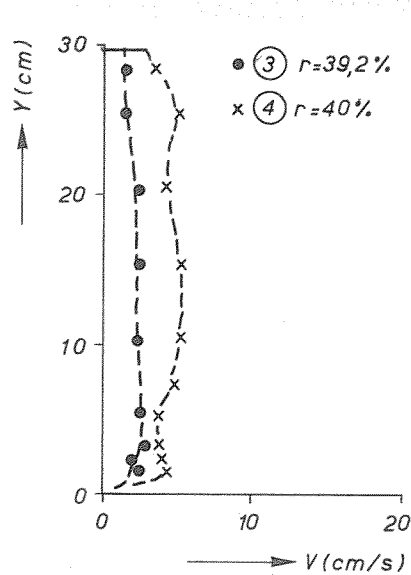
$h_0=29,9$ cm

A4

WATERLOOPKUNDIG LABORATORIUM

M.1201-1035

FIG. II-86



SNELHEIDSVERDELINGEN $Q = 152$ l/s

$T_6 - 152$

WK

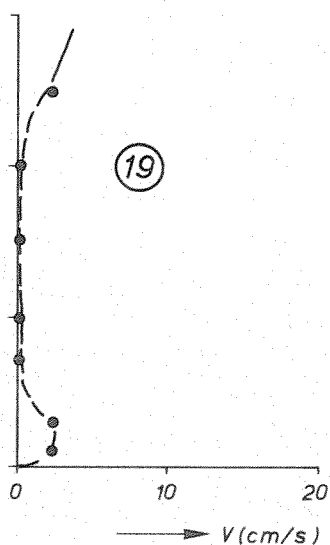
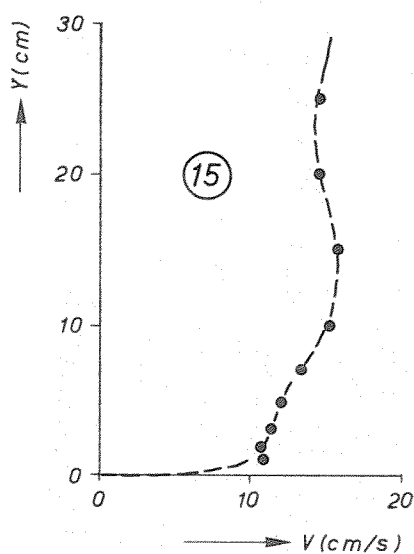
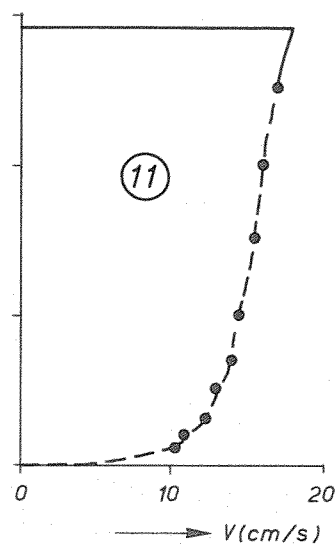
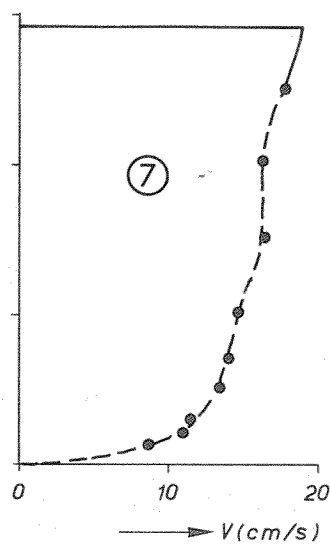
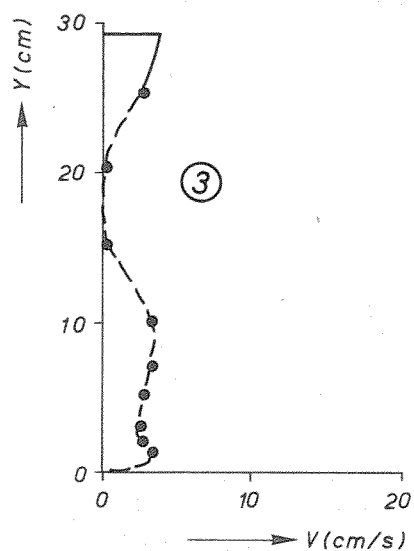
$h_0 = 29.6$ cm

A4

WATERLOOPKUNDIG LABORATORIUM

M.1201 - 1036

FIG. II-87



SNELHEIDSVERDELINGEN $Q = 122 \text{ l/s}$

$T_7 - 122$

WK

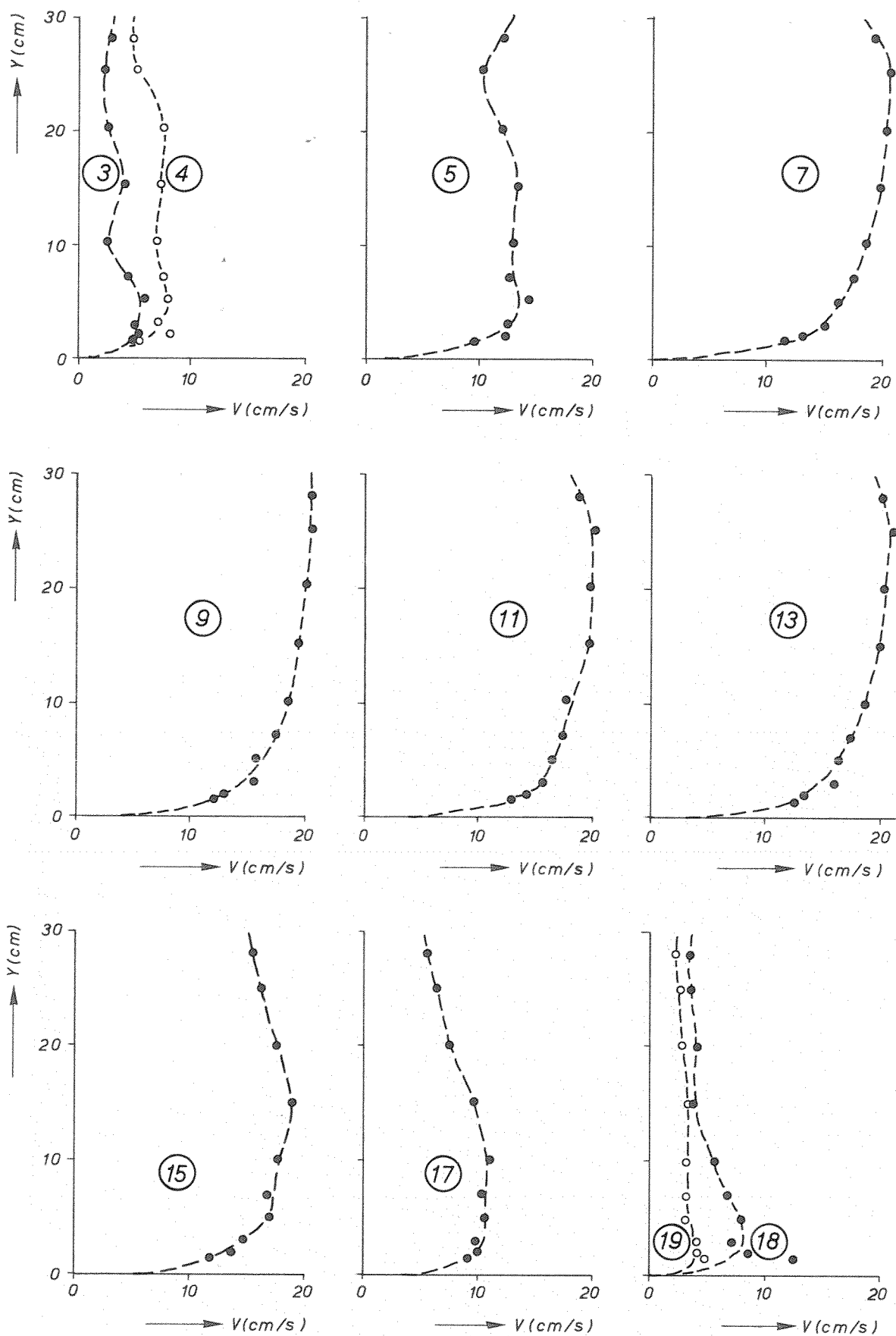
$h_0 = 29,0 \text{ cm}$

A4

WATERLOOPKUNDIG LABORATORIUM

M.1201 - 1037

FIG. II-88



SNELHEIDSVERDELINGEN $Q = 152 \text{ l/s}$

$T_7 - 152$

WK

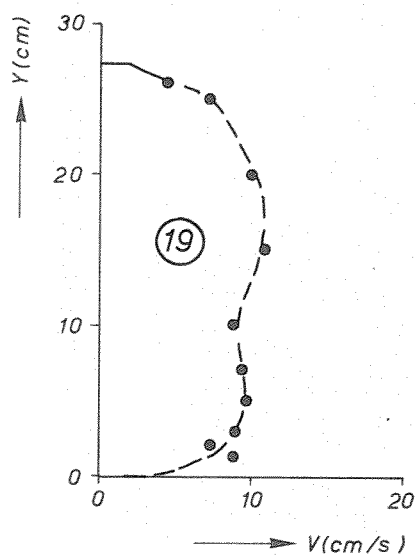
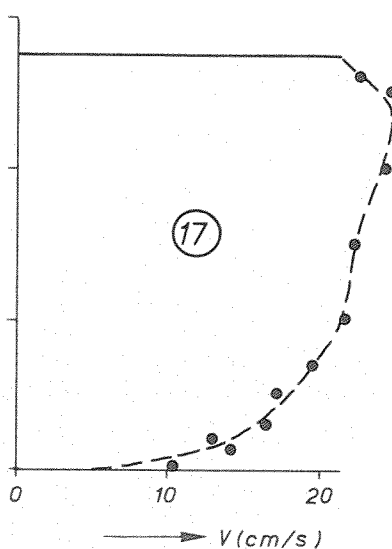
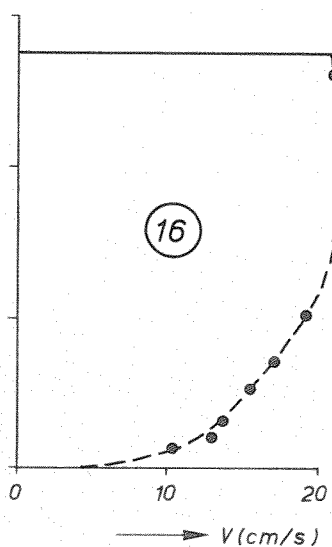
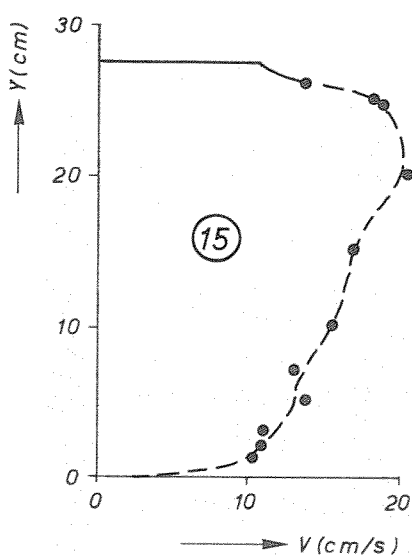
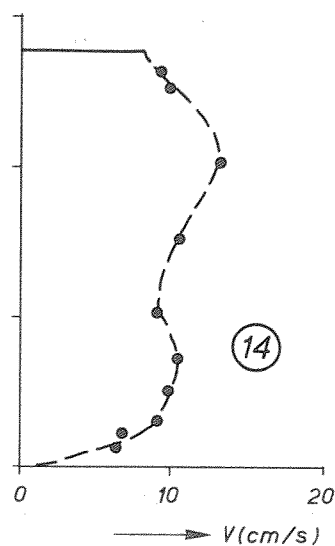
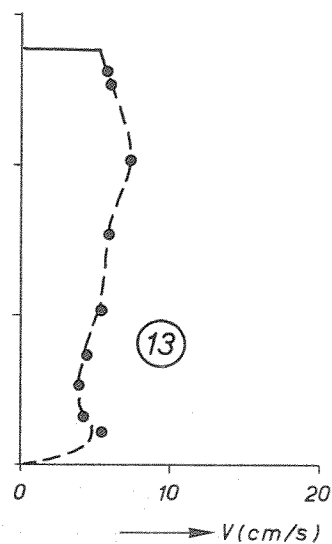
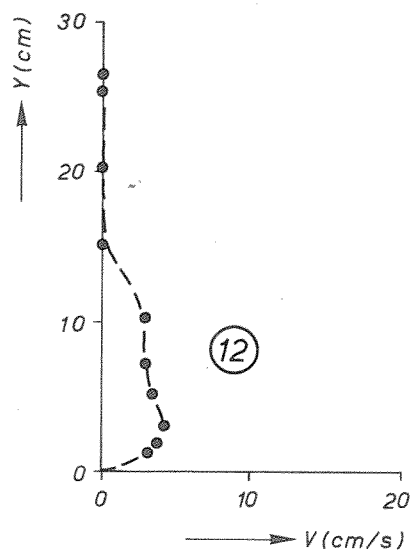
$h_0 = 29,9 \text{ cm}$

A4

WATERLOOPKUNDIG LABORATORIUM

M.1201 - 1038

FIG. II-89



SNELHEIDSVERDELINGEN $Q = 51$ l/s

$T_7^B - 51$

WK

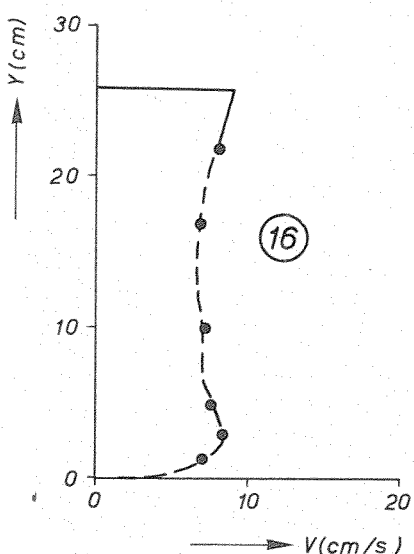
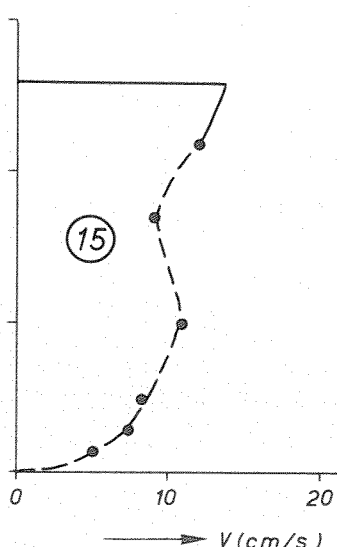
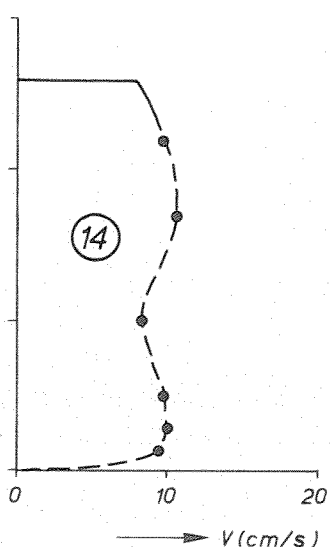
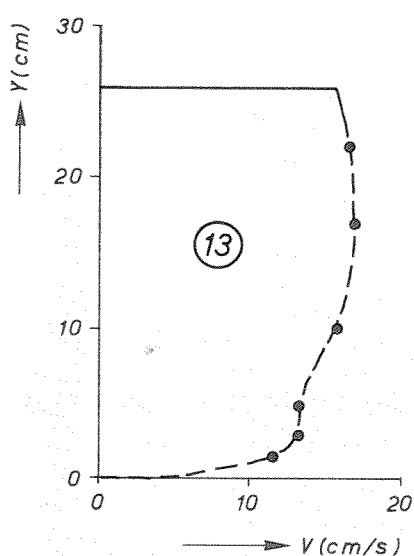
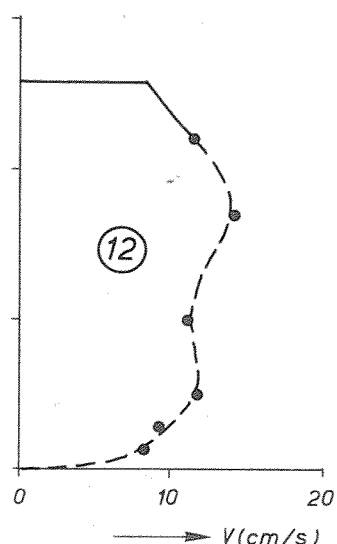
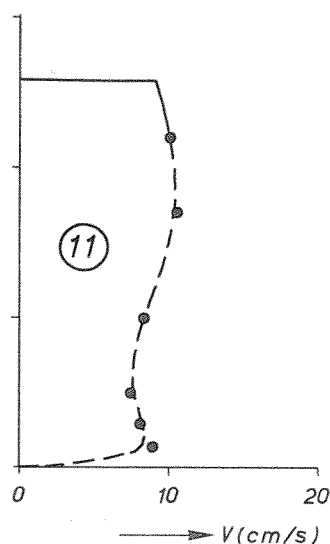
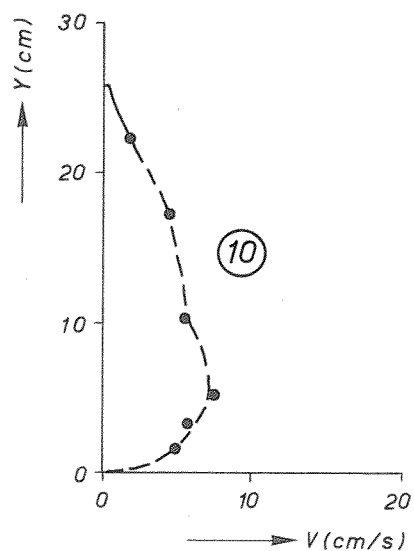
$h_0 = 27,3$ cm

A4

WATERLOOPKUNDIG LABORATORIUM

M.1201-1039

FIG. II-90



SNELHEIDSVERDELINGEN $Q = 26 \text{ l/s}$

$T_7^c - 26$

WK

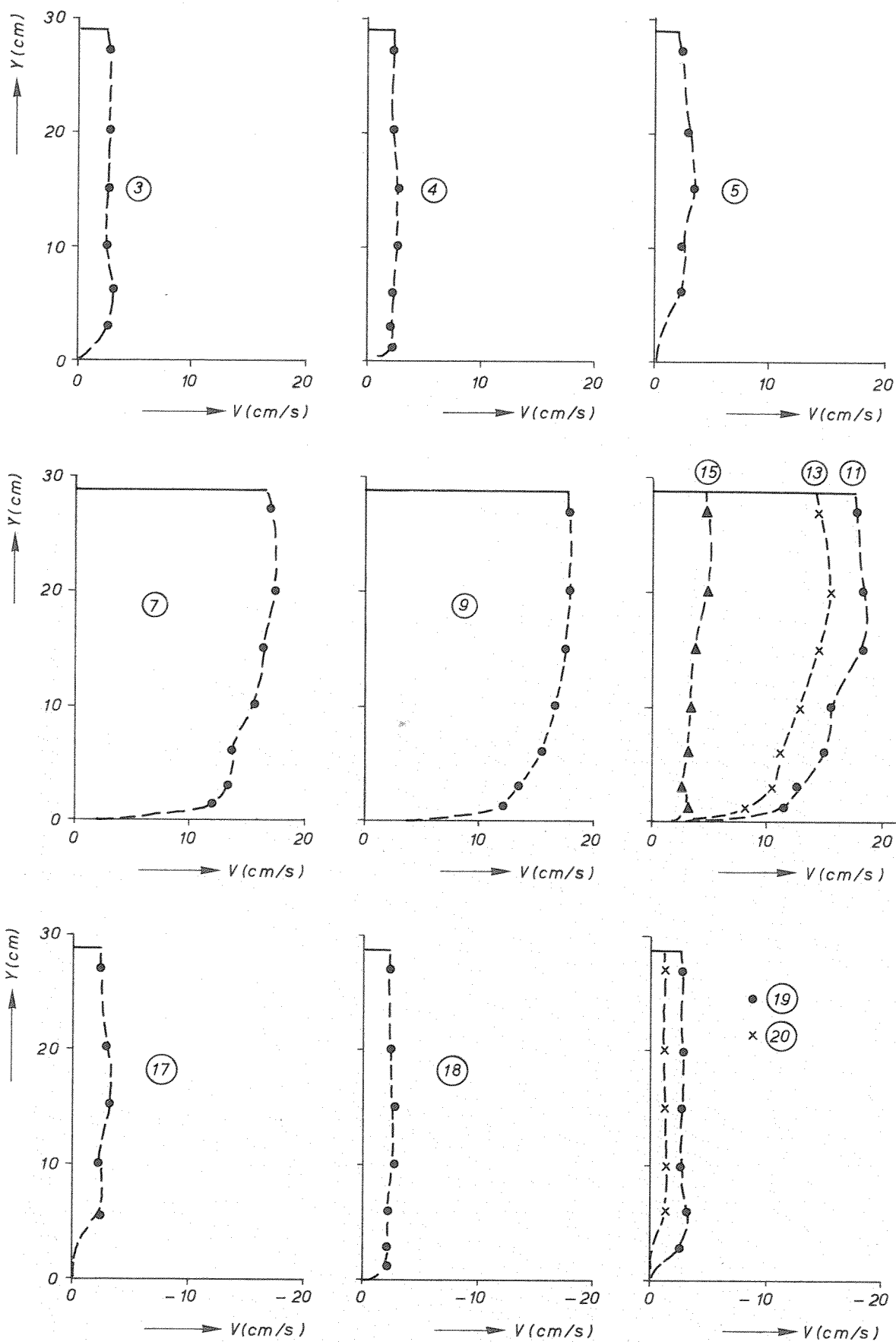
$h_0 = 25,9 \text{ cm}$

A4

WATERLOOPKUNDIG LABORATORIUM

M.1201 - 1040

FIG. II-91



SNELHEIDSVERDELINGEN $Q = 102 \text{ l/s}$

$T_7^6 - 102$

WK

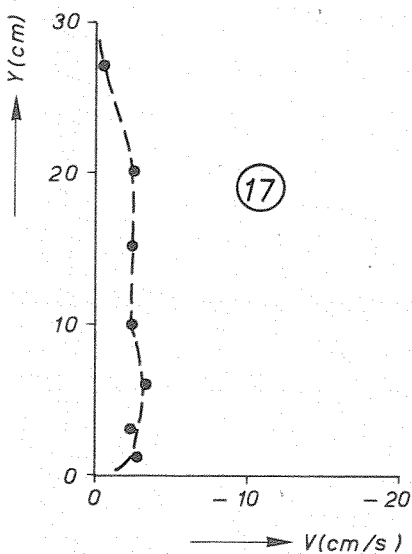
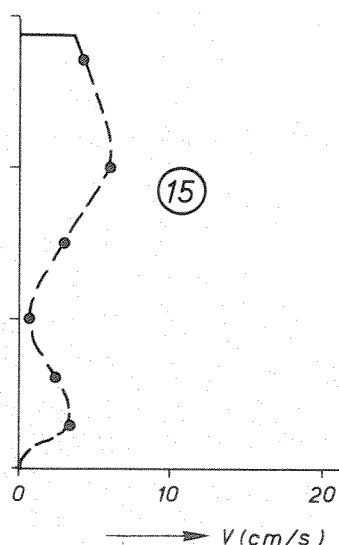
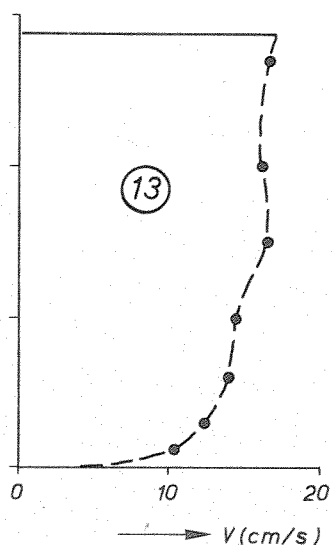
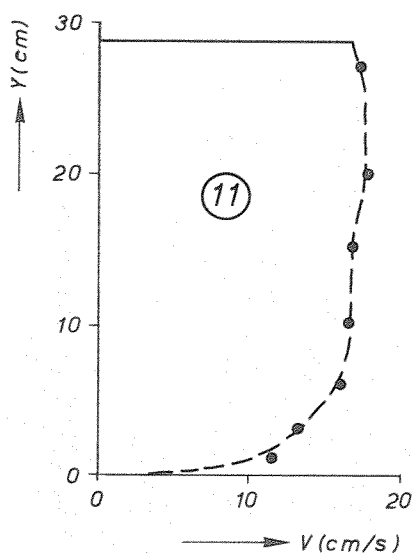
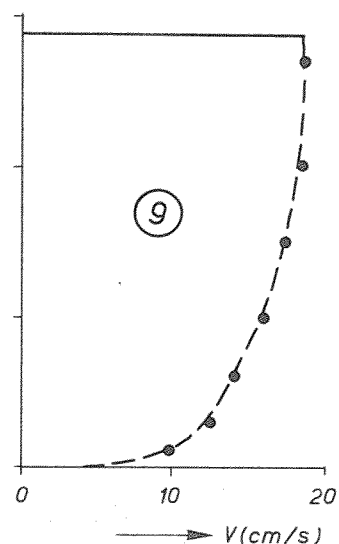
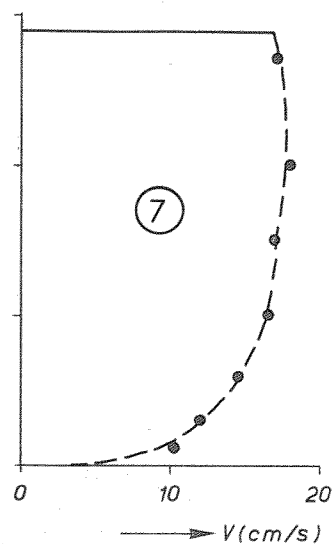
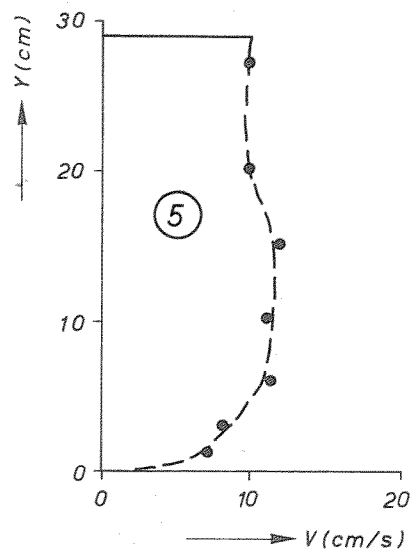
$h_0 = 28,7 \text{ cm}$

A4

WATERLOOPKUNDIG LABORATORIUM

M.1201 - 1041

FIG. II- 92



SNELHEIDSVERDELINGEN $Q = 102 \text{ l/s}$

$T_8 - 102$

WK

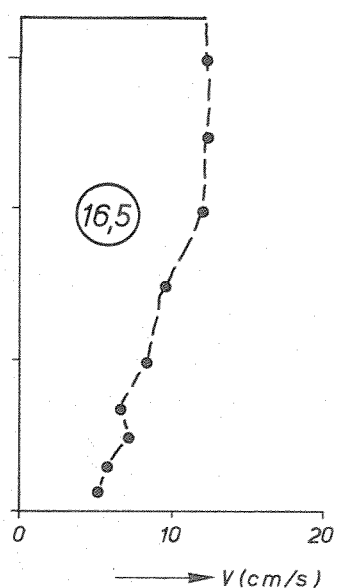
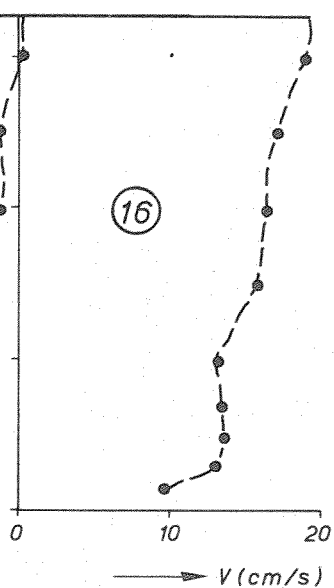
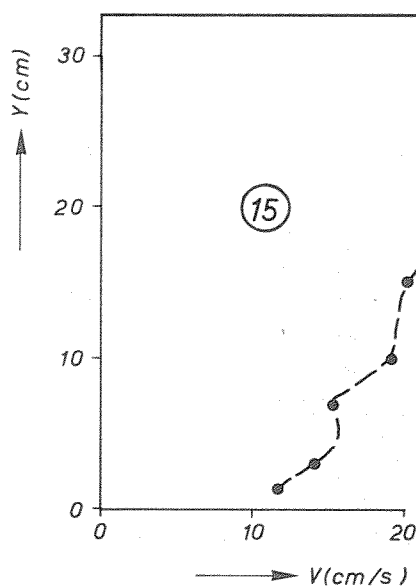
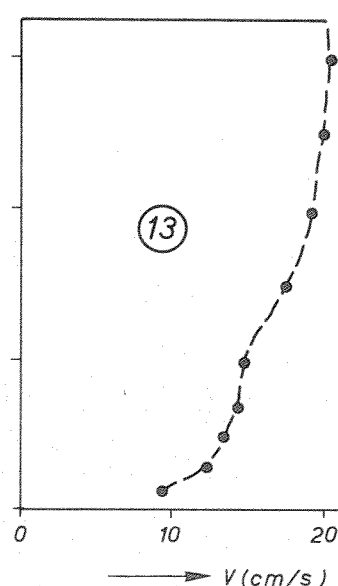
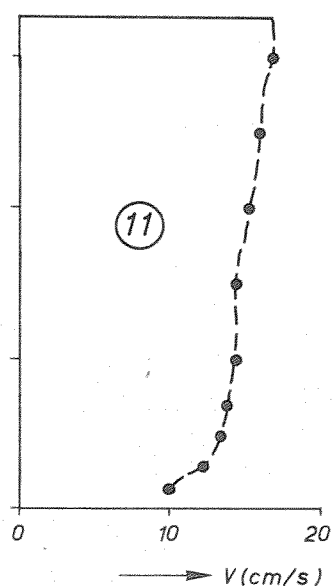
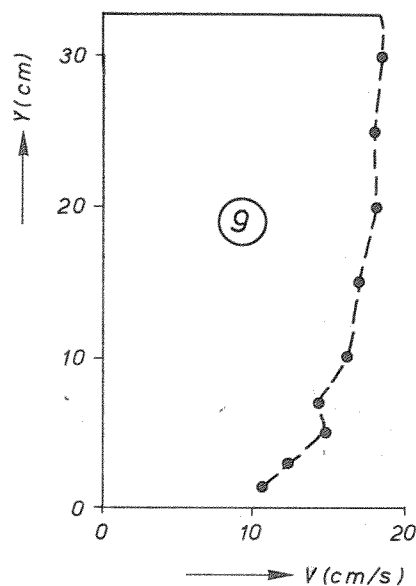
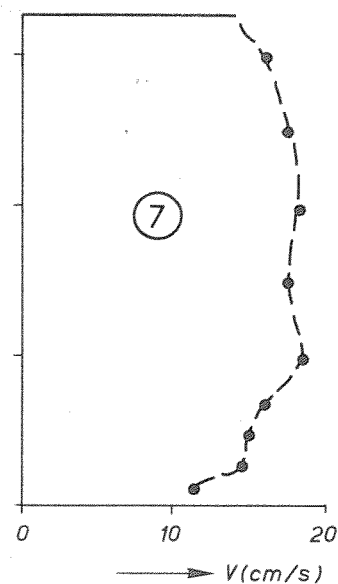
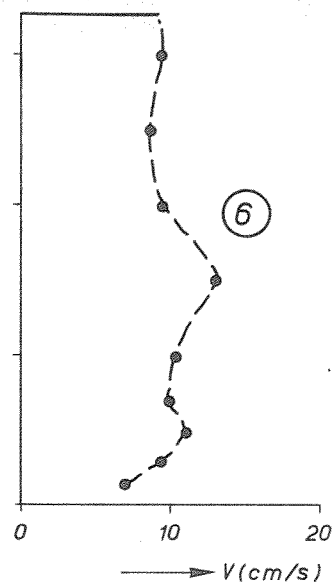
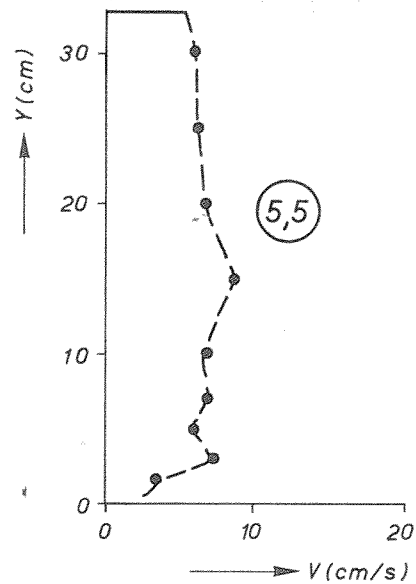
$h_0 = 28,7 \text{ cm}$

A4

WATERLOOPKUNDIG LABORATORIUM

M.1201 - 1042

FIG. II-93



SNELHEIDSVERDELINGEN $Q=150$ l/s

T_g-150

WK

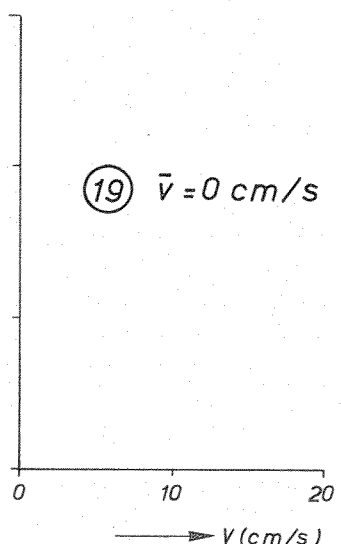
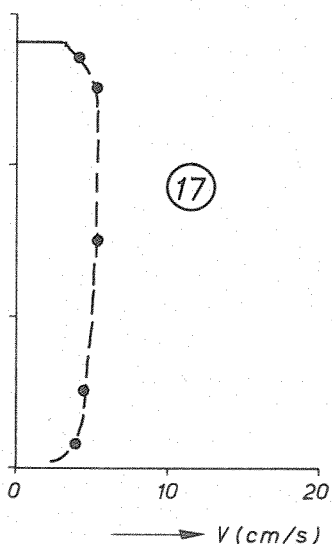
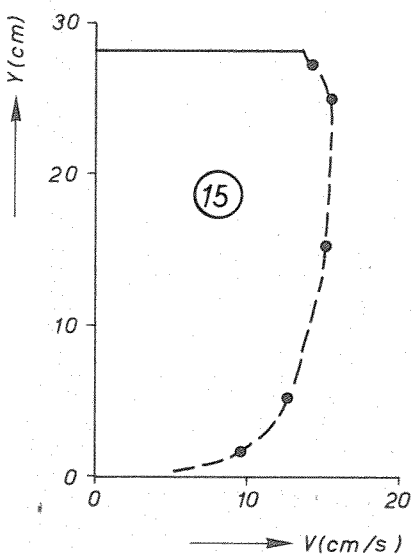
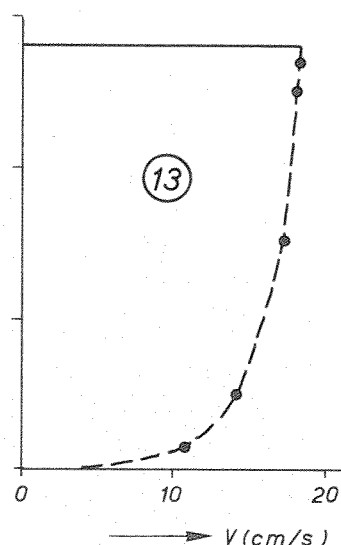
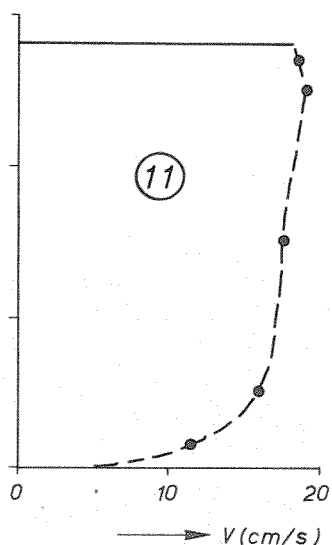
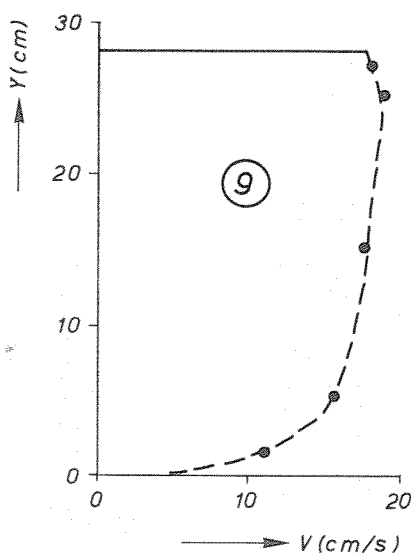
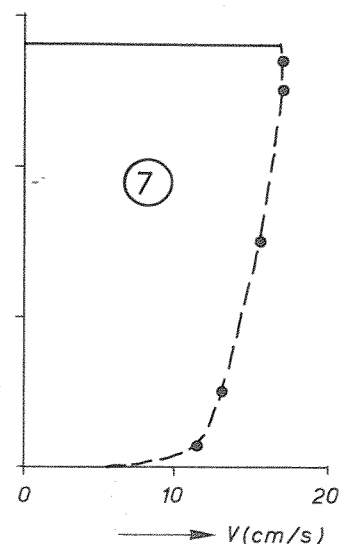
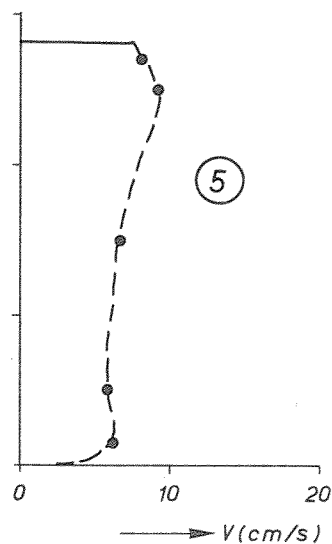
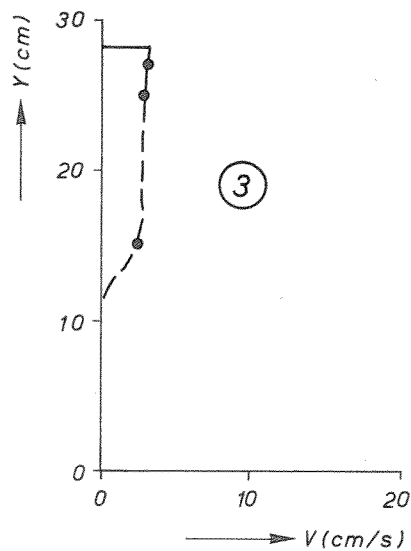
$h_o=32,7$ cm

A4

WATERLOOPKUNDIG LABORATORIUM

M.1201-1043

FIG. II-94



SNELHEIDSVERDELINGEN $Q = 120$ l/s

$T_{11} - 120$

WK

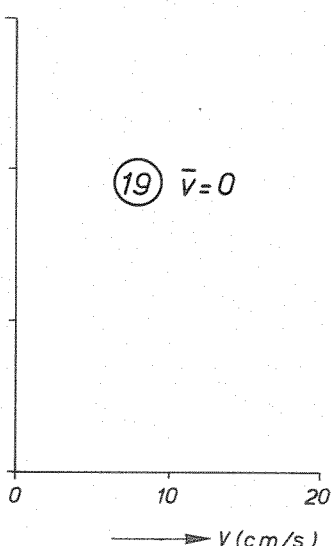
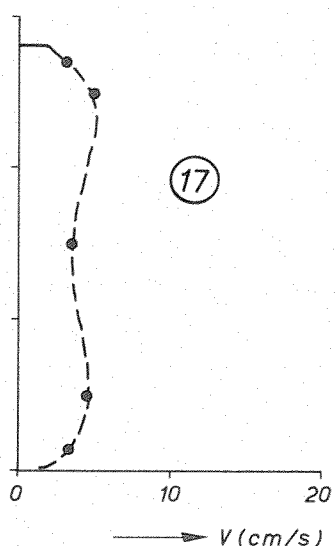
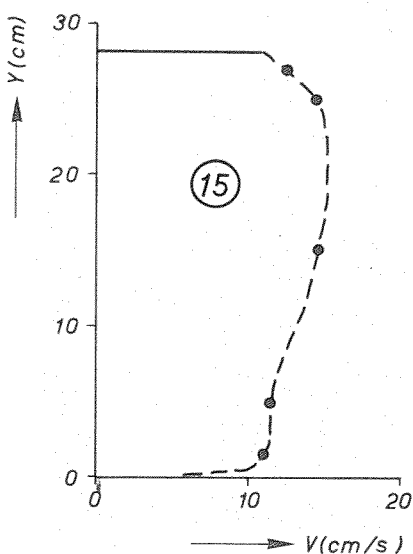
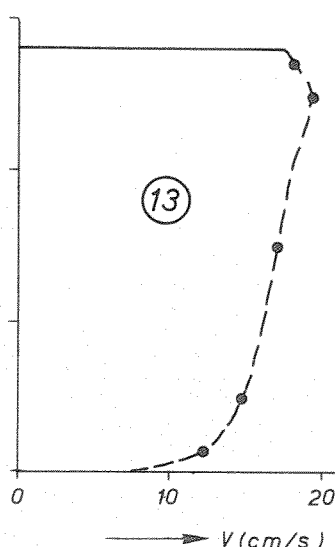
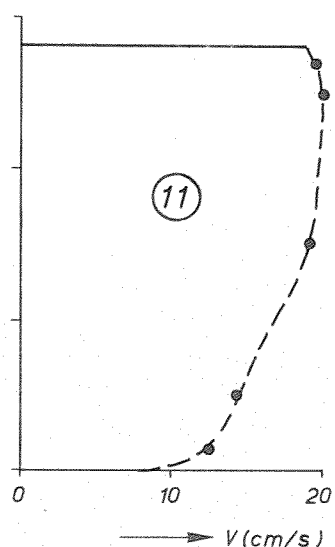
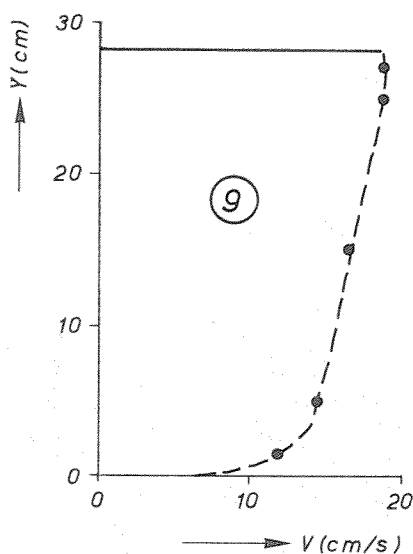
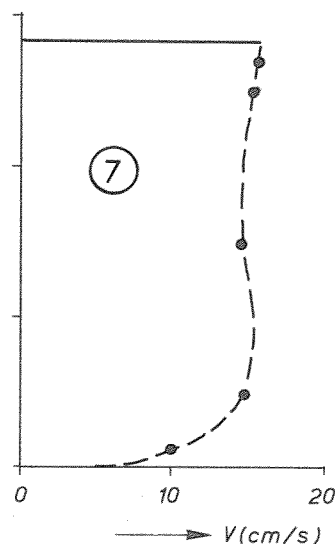
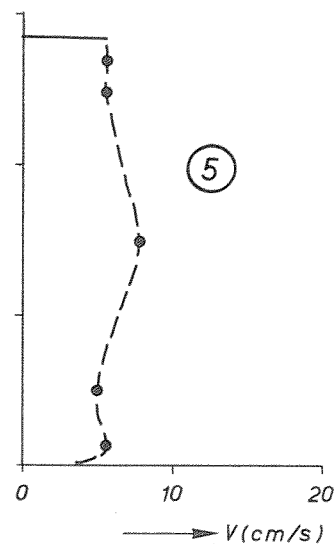
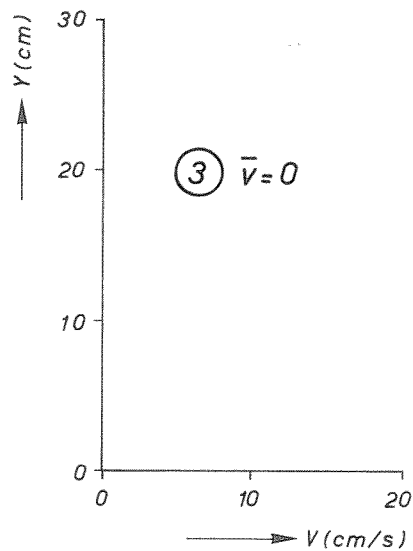
$h_0 = 28,1$ cm

A4

WATERLOOPKUNDIG LABORATORIUM

M.1201 - 1044

FIG. II-95



SNELHEIDSVERDELINGEN $Q = 120 \text{ l/s}$

$T_{12} = 120$

WK

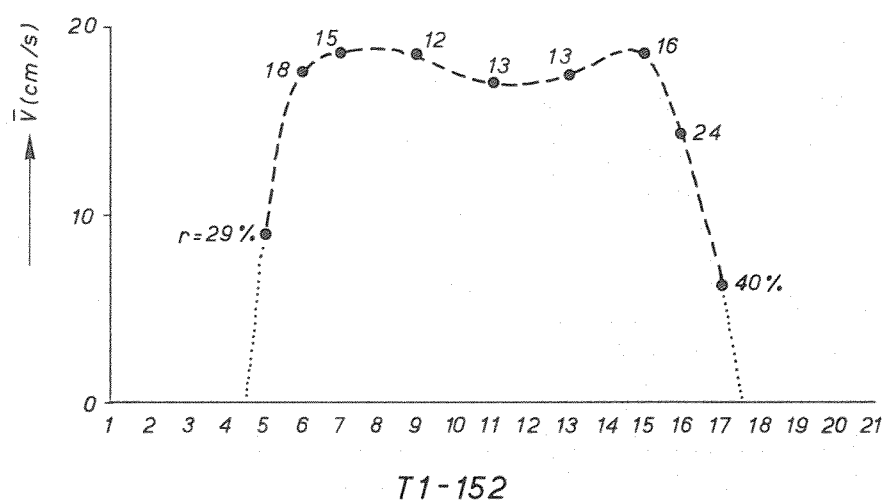
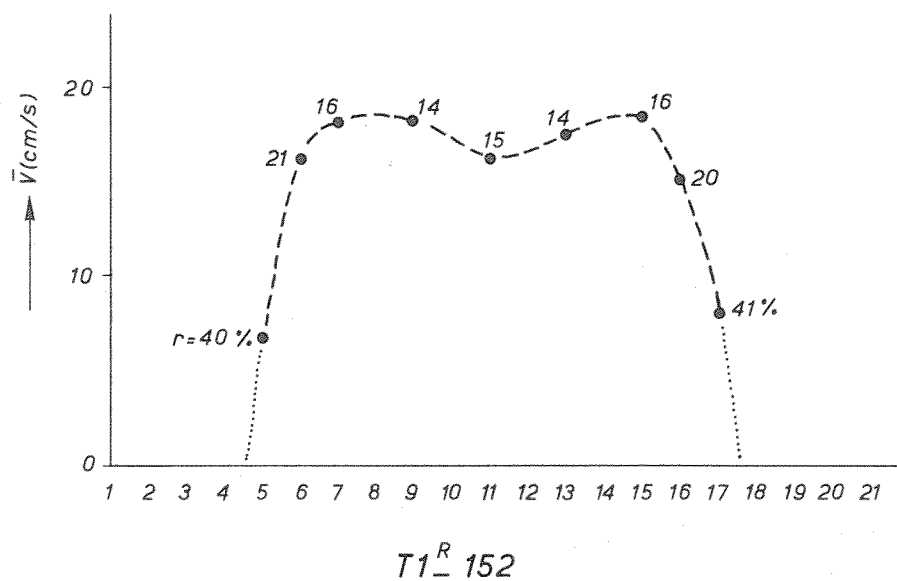
$h_0 = 28,3 \text{ cm}$

A4

WATERLOOPKUNDIG LABORATORIUM

M.1201 - 1045

FIG. II-96



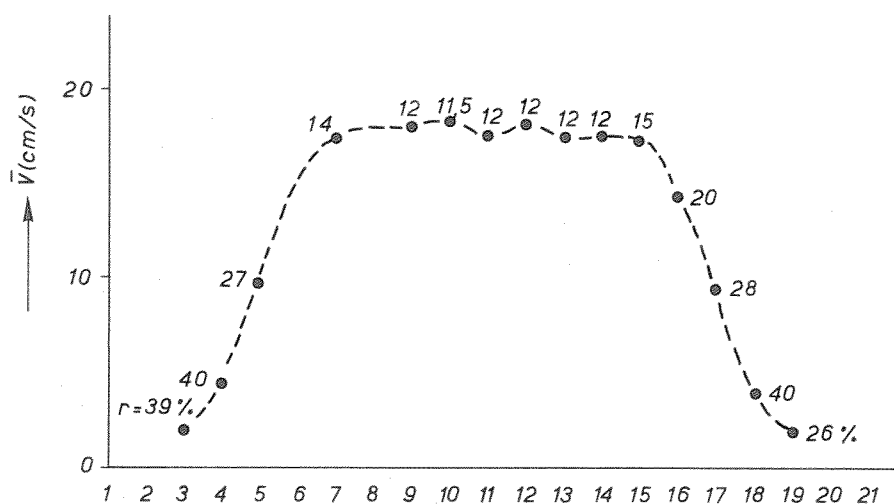
HORIZONTALE GEMIDDELDE SNELHEIDSVERDELINGEN OP $X=0$

WK

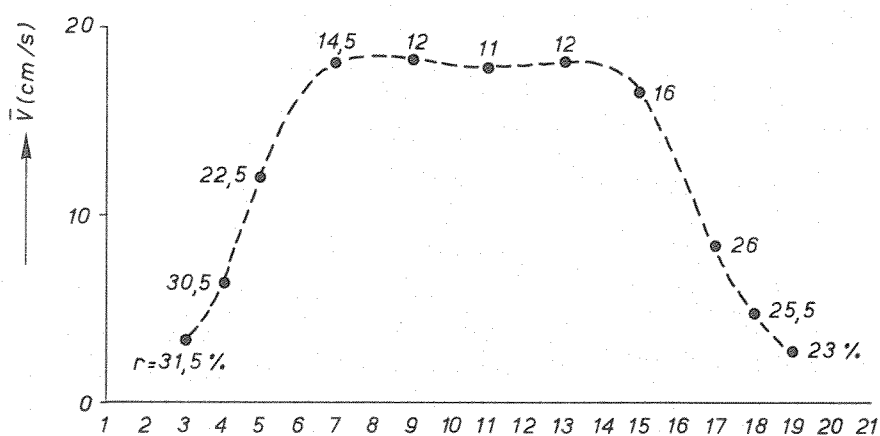
A4

WATERLOOPKUNDIG LABORATORIUM

M.1201-1046 FIG. II-97



T6-152



T7-152

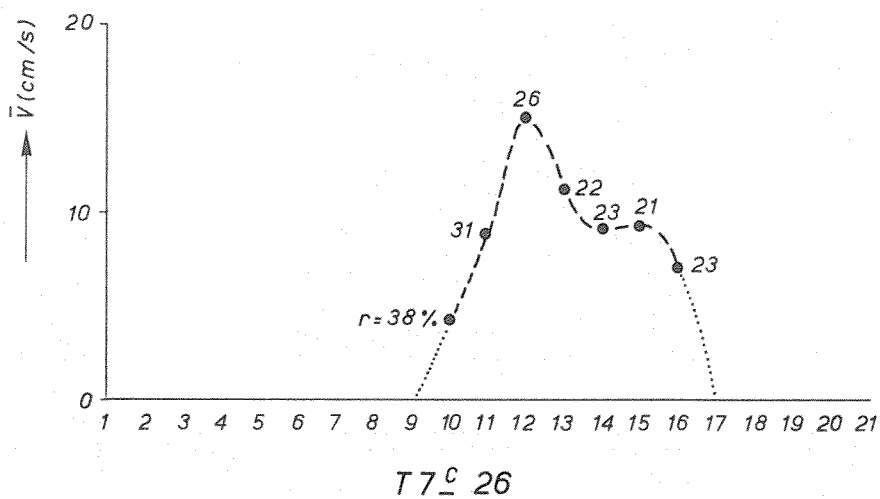
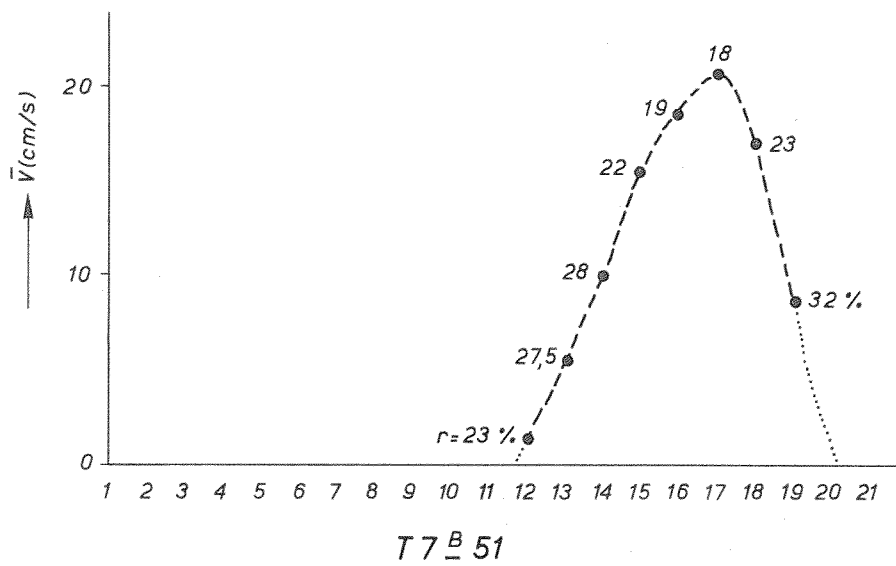
HORIZONTALE GEMIDDELDE SNELHEIDSVERDELINGEN OP $X=0$

WK

A4

WATERLOOPKUNDIG LABORATORIUM

M.1201-1047 FIG. II-98



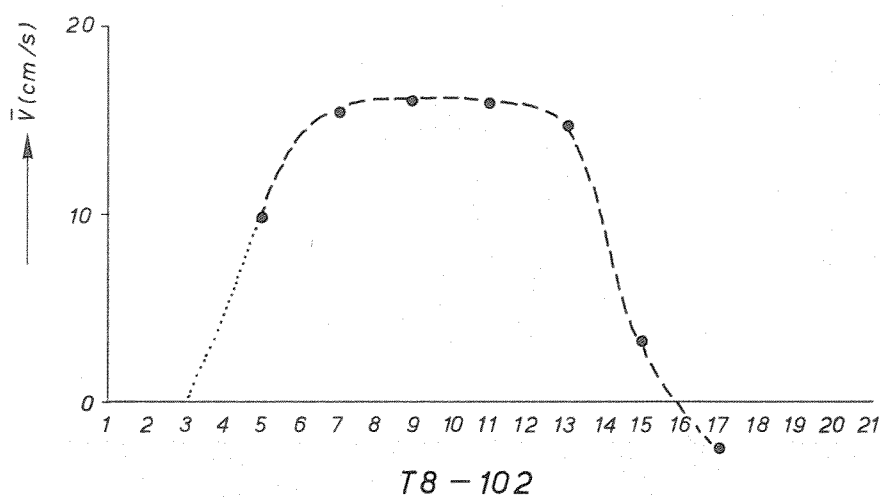
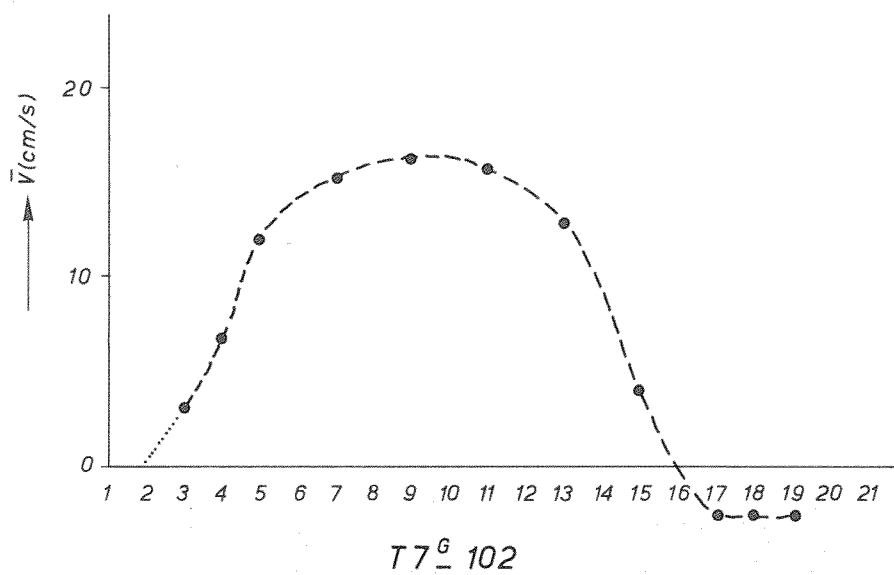
HORIZONTALE GEMIDDELDE SNELHEIDSVERDELINGEN OP $X=0$

WK

A4

WATERLOOPKUNDIG LABORATORIUM

M.1201-1048 FIG. II-99



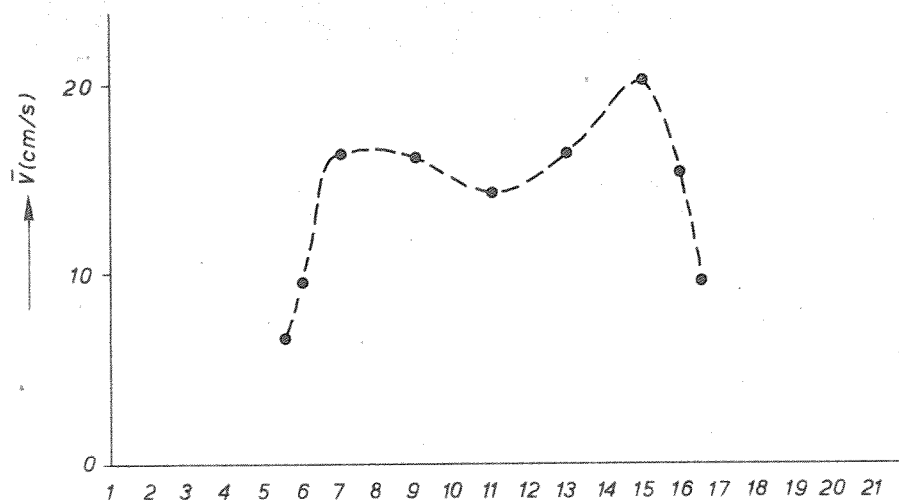
HORIZONTALE GEMIDDELDE SNELHEIDSVERDELINGEN OP $X=0$

WK

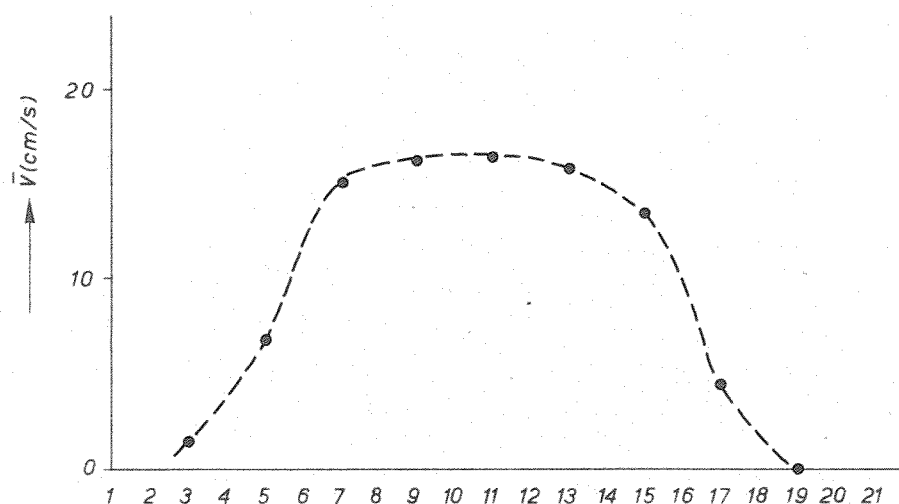
A4

WATERLOOPKUNDIG LABORATORIUM

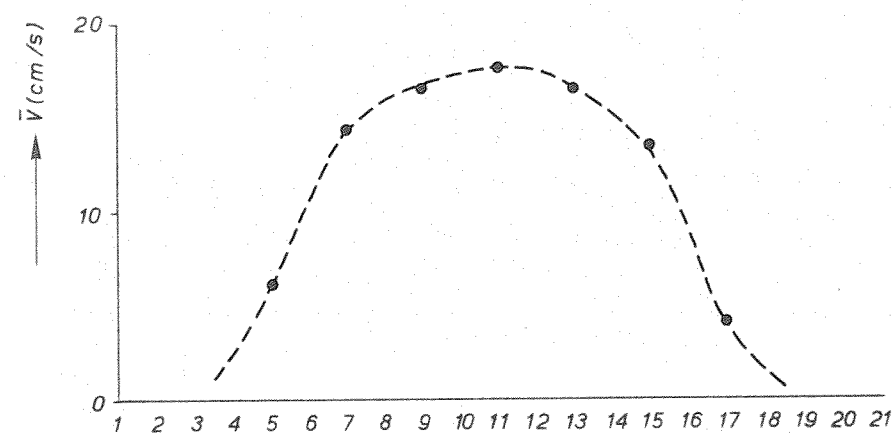
M.1201-1049 FIG. II-100



T 9-150



T 11-120



T 12-120

HORIZONTALE GEMIDDELDE SNELHEIDSVERDELINGEN OP $X=0$

WK

A4

WATERLOOPKUNDIG LABORATORIUM

M.1201- 1050

FIG.II-101

1 Probleemstelling

Als alternatieve oplossing van een grote uitbreiding van het stortebed aan de zeezijde van de uitlaatsluis in de Oosterscheldedam, wordt gedacht aan het toepassen van een damwand als beëindiging van de bodemverdediging.

Als gevolg van heen en weer gaande stromen zal langs de rand van het stortebed ontgronding kunnen optreden. Met betrekking tot de vorm van de ontgrondingskuil, welke wordt veroorzaakt door spuidebieten door de sluis, is vrij veel bekend uit verrichte modelproeven. In het algemeen ontstaat een kuil waarvan de aanzet min of meer samenvalt met de rand van de bodemverdediging, terwijl het diepste punt van de kuil zich op enige afstand van de bodemverdediging bevindt. Daarentegen was echter niet bekend wat de invloed is van een stroom in tegengestelde richting op de ontgronding aan de rand van het stortebed. Gevreesd werd dat een diepe ontgronding zal kunnen ontstaan nabij de damwand. Teneinde daaromtrent meer kennis te verzamelen zijn in het Laboratorium De Voorst enige principeproeven uitgevoerd, waarvan de resultaten in het navolgende worden beschreven.

2 Model

Het onderzoek is uitgevoerd in een stroomgoot met een effectieve lengte van 33 m en een breedte van 0,50 m. Met behulp van meetstuwen aan beide einden van de goot kunnen zowel uitlaat- als inlaatdebieten worden ingesteld. Als bodemmateriaal is bakeliet gebruikt ($D_m = 700 \mu$).

3 Metingen

De bodemligging is vastgesteld met behulp van een peilstok. Per dwarsraai is de gemiddelde diepte bepaald uit drie peilingen in de betreffende raai. De waterstand in het model werd op een drietal plaatsen, bovenstrooms, boven de drempel en benedenstrooms, gemeten met behulp van pitotbuizen. In een aantal gevallen zijn stroomsnelheden gemeten langs de vertikaal, met behulp van een Ott-molen.

4 Modelonderzoek

Situatie T1-A

De drempel met een verhoging van 0,15 m is gelegen tussen de raaien 7,5 en 11,0 (figuur II - 102). Het debiet Q bedraagt in beide richtingen (heen en terug) $0,040 \text{ m}^3/\text{s}$.

De waterdiepte $d = 0,60 \text{ m}$ ten opzichte van de vaste gootbodem, tijdens het uitlaatdebiet (heen) in raai 19,0 en tijdens het inlaatdebiet (terug) in raai 6,5.

Tijdens de eerste 3 uren van de proef is in de heen-richting gestroomd, ten gevolge waarvan de bekende ontgrondingskuil is ontstaan met een diepte van 0,14 m en een aanzethelling van 1 : 5. Vervolgens is 2 uren in tegengestelde richting gestroomd, waarbij enige aanzanding plaatsvindt in de kuil, doch waarbij tevens een verdieping ontstaat tegen de verticale beëindiging van de drempel aan. De verdieping bedraagt 0,05 à 0,06 m (zie figuren II - 103 en II - 104).

Situatie T1-B

De ingestelde randvoorwaarden zijn dezelfde als in T1-A, met dien verstande dat de drempel over een afstand van 0,45 m is verschoven, teneinde het ontgrondingsproces beter te kunnen waarnemen. Er is zowel in heen- als terugrichting 2 uren gestroomd, waarbij het ontgrondingsproces zich sneller blijkt te voltrekken (figuren II - 105 en II - 106). De verdieping naast de drempel bedraagt nu aan het eind van de proef ca. 0,13 m. Deze resultaten mogen echter niet al te serieus worden genomen, aangezien de drempel tijdens de proef onderloops bleek te zijn, hetgeen uiteraard een versnelde ontgroning tot gevolg heeft.

Situatie T2

Er is nu sprake van een drempel zonder verhoging. Het debiet Q bedraagt $0,050 \text{ m}^3/\text{s}$ in beide richtingen. De waterdiepte d bedraagt 0,60 m ten opzichte van de vaste bodem in meetraai 19,0 tijdens het heenstromen en in raai 2,5 tijdens het terugstromen.

Tijdens de periode van 3 uren dat in de heenrichting is gestroomd is een ontgrondingskuil ontstaan met een diepte van 0,11 m, en een aanzethelling 1 : 4. Tijdens het terugstromen ontstaat aanvankelijk een verdieping naast de drempel van ca. 0,18 m na 2 uren stromen, doch na 3 uren stromen is deze kuil al weer grotendeels opgevuld. In het model blijken grote ribbels te ontstaan ter lengte van 1 à 2 m, die de ontstane verdieping vrij abrupt weer opvullen (figuren II - 107 en II - 108).

Situatie T3

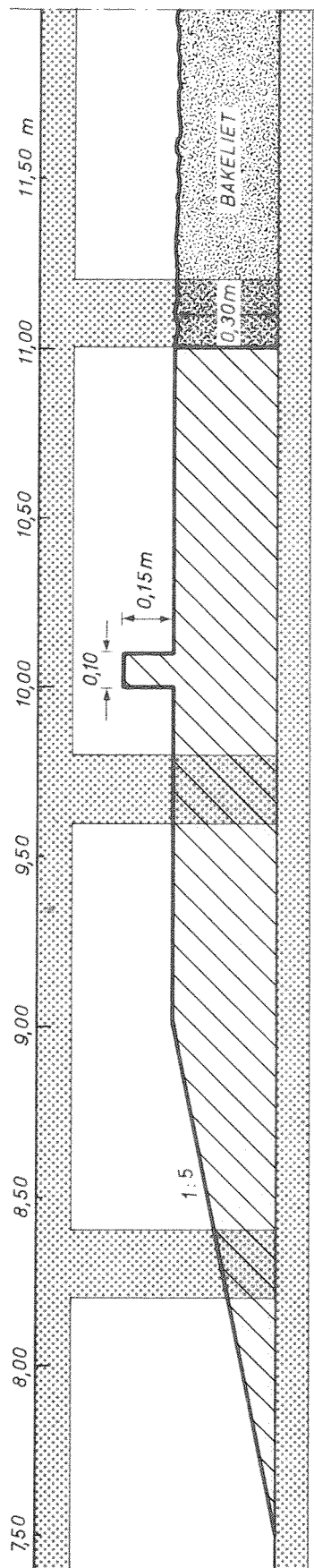
In vergelijking met de vorige situatie zijn de debieten verlaagd tot $0,040 \text{ m}^3/\text{s}$. In de heenrichting is 10 uren gestroomd, waardoor een ontgrondingskuil ter diepte van $0,06 \text{ à } 0,07 \text{ m}$ ontstaat, terwijl de aanzethelling ongeveer $1 : 4\frac{1}{2}$ is. In omgekeerde richting stromend ontstaat periodiek een verdieping naast de verticale beëindiging van de drempel. Deze verdieping is bijvoorbeeld gemeten na respectievelijk $1\frac{1}{2}$ en 3 uren stromen, terwijl de verdieping vrijwel geheel was opgevuld na $\frac{1}{2}$ en $2\frac{1}{2}$ uren stromen (figuren II - 110 en II - 111).

Situatie T4

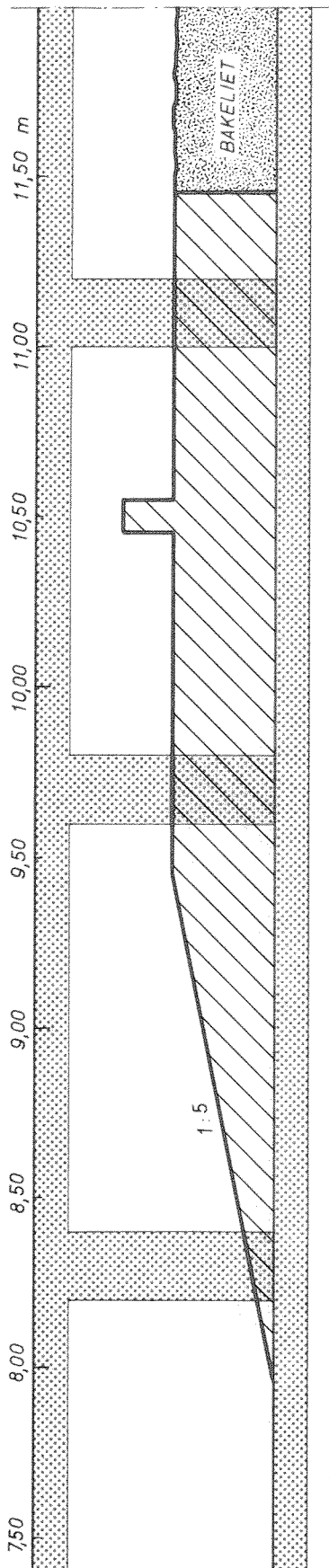
In vergelijking met de vorige situatie is het debiet na $0,060 \text{ m}^3/\text{s}$. Er is slechts 1 uur in de heen-richting gestroomd. Op dat moment zijn de proeven, in overleg met de opdrachtgever, beëindigd.

5 Konklusie

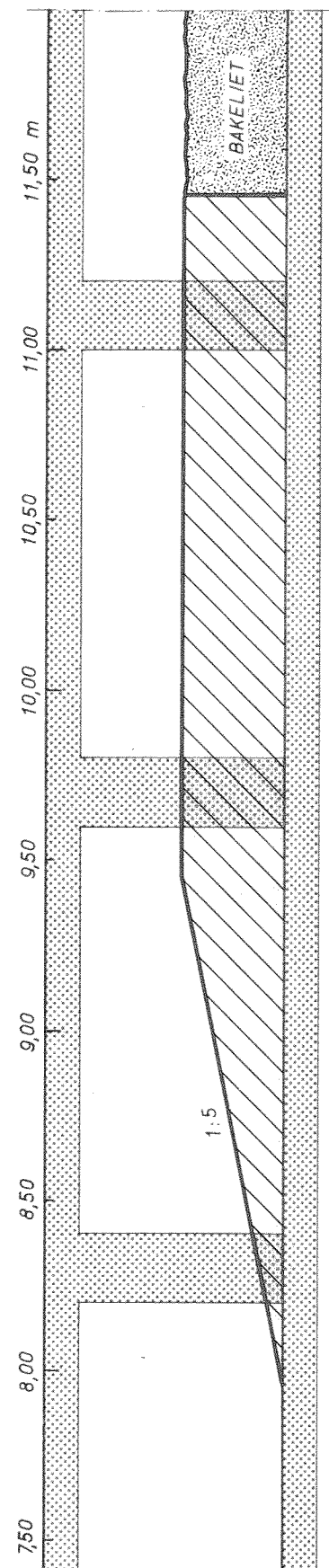
De vrees dat ontgroning zal kunnen optreden nabij de verticale beëindiging van een stortebed blijkt gerechtvaardigd te zijn. Deze ontgroning ontstaat tengevolge van een inlaatdebiet, nadat tengevolge van de uitlaatdebieten reeds een "normale" ontgrondingskuil is ontstaan.



T 1-A



T 1-B



T 2, T 3, T 4

ONDERZOCHE TOESTANDEN

SCHAAL 1:20

K_M

A4

WATERLOOPKUNDIG LABORATORIUM

M.1201-1052

FIG.II-102

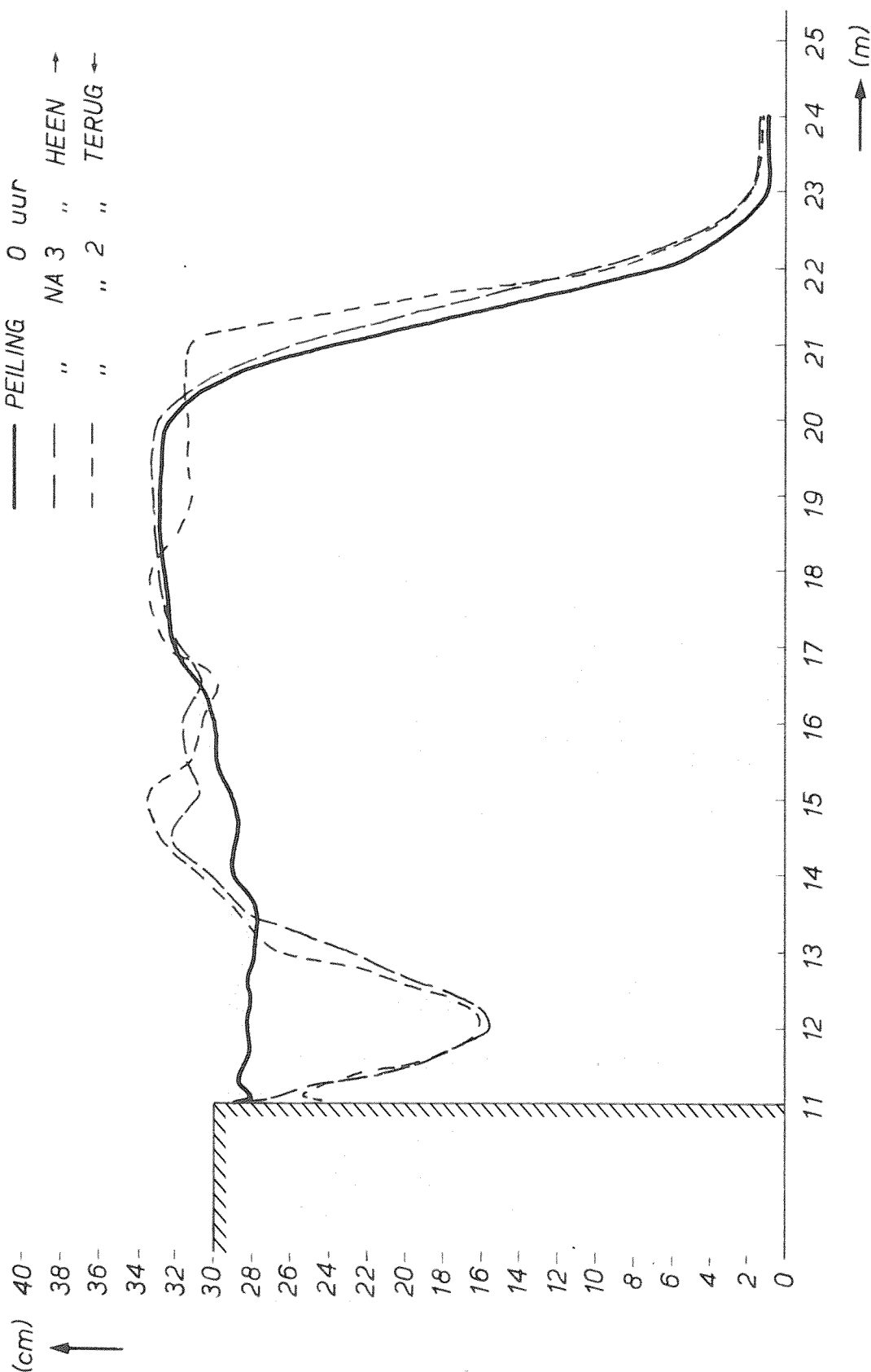
T1-A

$Q = 40 \text{ l/s}$

HEEN : $d = 60 \text{ cm}$ IN m.p. 19m t.o.v. VASTE BODEM

TERUG : $d \approx 60 \text{ cm}$ IN m.p. 6,5m

— PEILING 0 uur
 - - - " NA 3 " HEEN →
 - - - " " 2 " TERUG ←



ONTGRONDINGEN BIJ RETOURSTROMING

K_M

A4

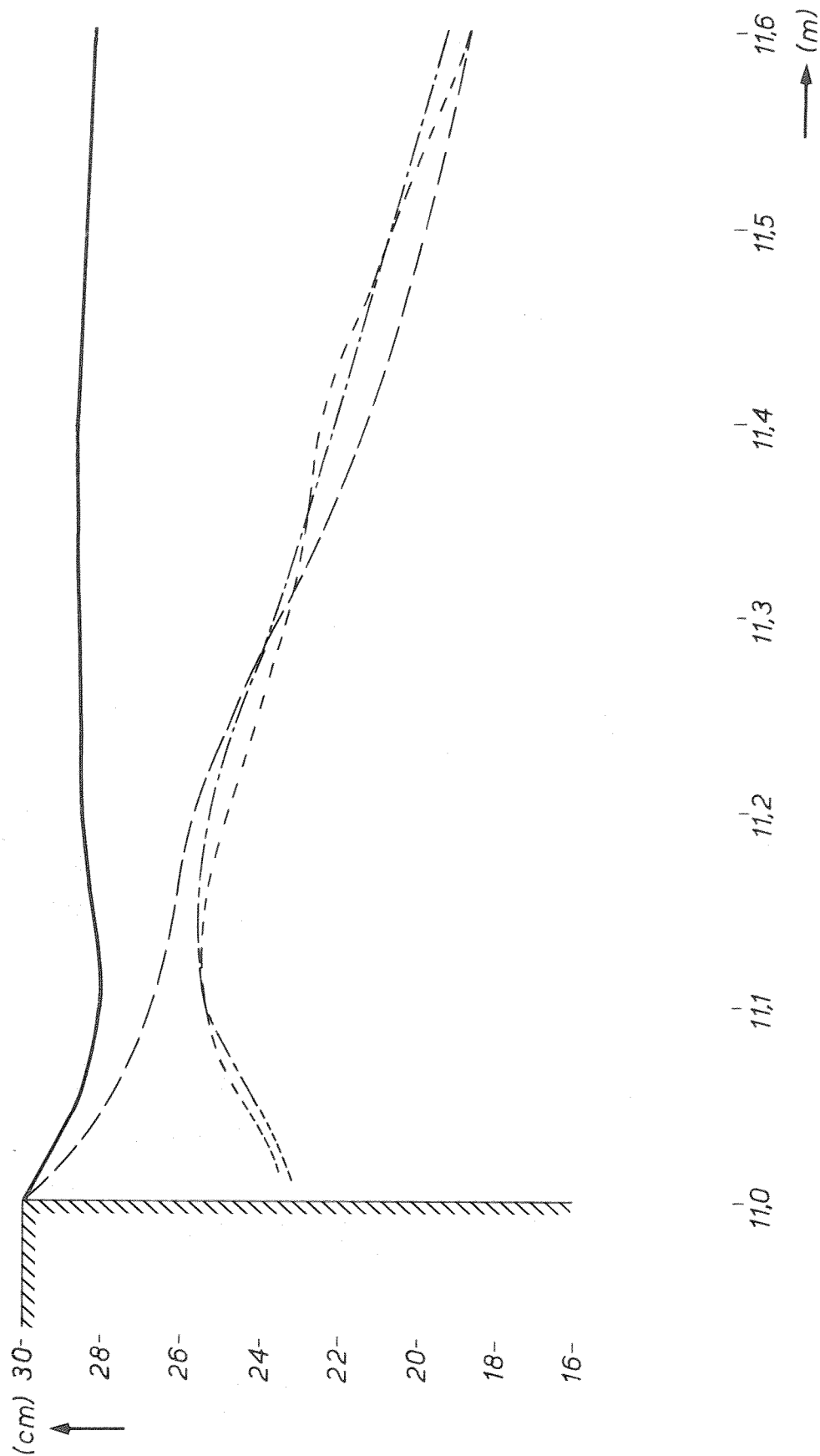
WATERLOOPKUNDIG LABORATORIUM

M.1201-1053

FIG. II-103

T1-A

— 0 uur
 - - - NA 3 " HEEN →
 - - - " 1 " TERUG ←
 - - - " 2 " " ←



ONTGRONDINGEN BU RETOURSTROMING

K_M

A4

WATERLOOPKUNDIG LABORATORIUM

M.1201-1054

FIG. II - 104

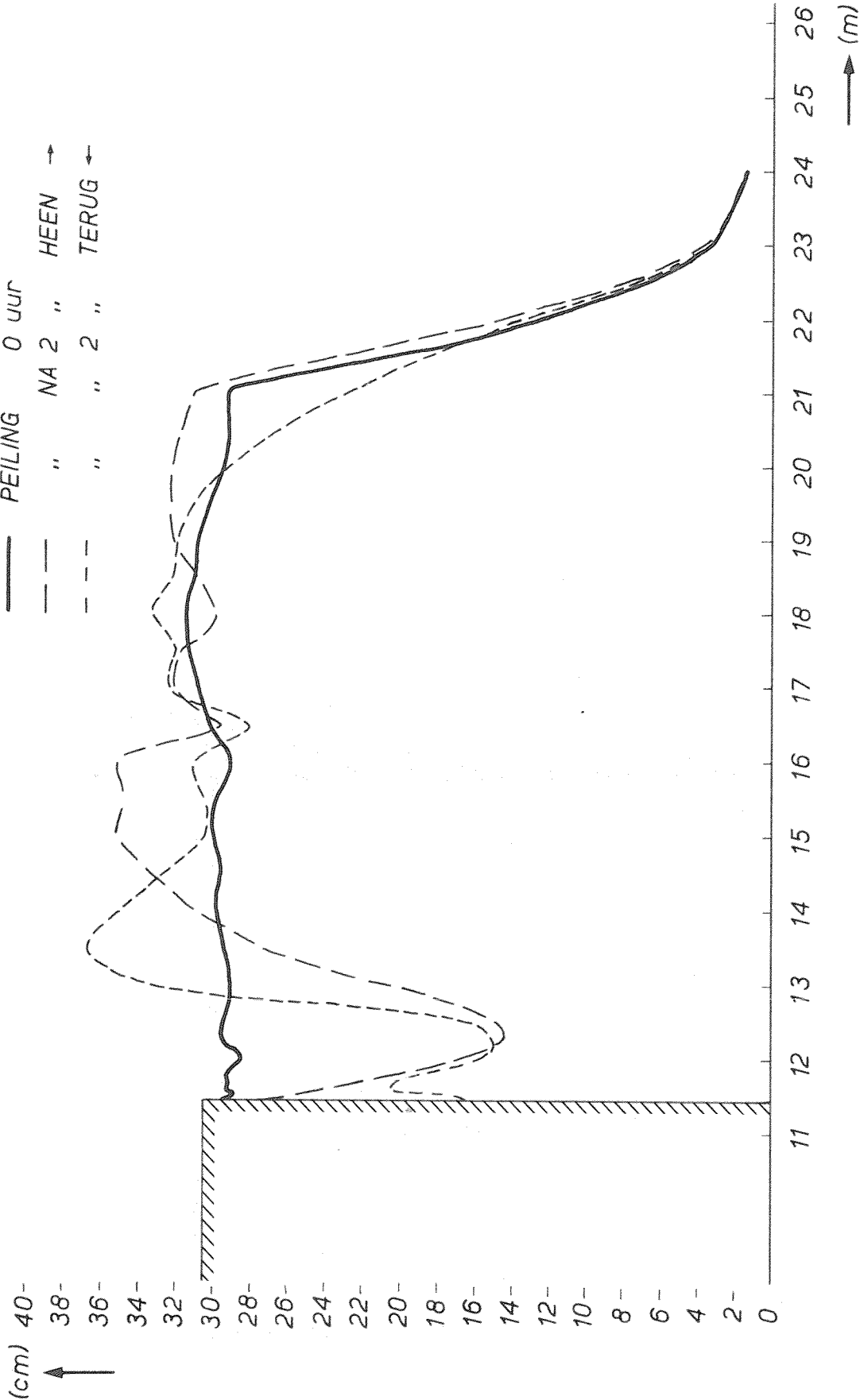
T1-B

Q = 40 l/s

HEEN : d = 60 cm t.o.v. VASTE BODEM (m.p. 19,0)

TERUG : d = 60 cm (m.p. 2,5)

— PEILING 0 uur
 - - - " NA 2 " HEEN →
 - - - " " 2 " TERUG ←



ONTGRONDINGEN BIJ RETOOURSTROMING

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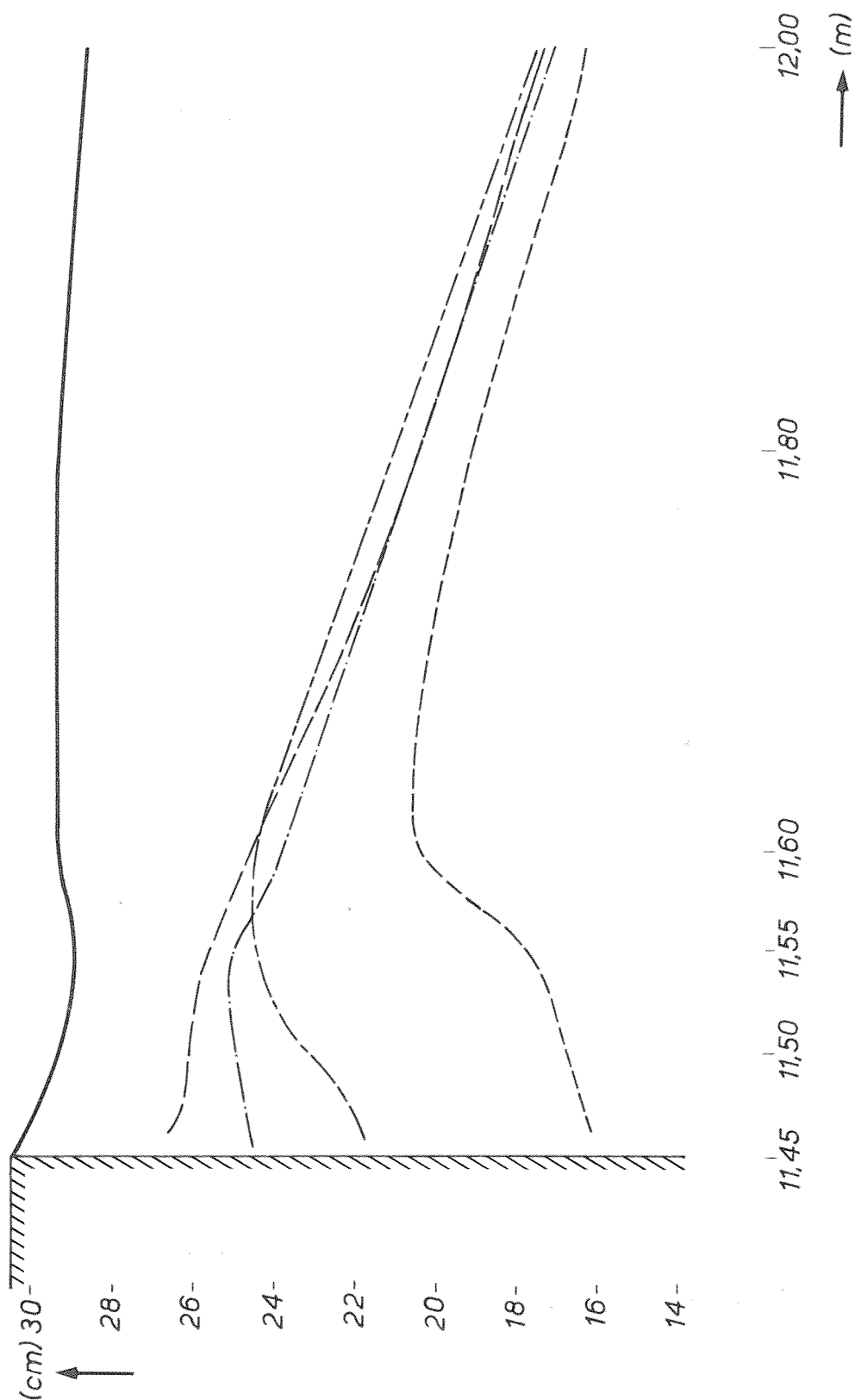
K_M

A₄

M.1201-1055 FIG. II-105

T1-B

—	0 uur	
- -	NA 2 "	HEEN →
- · -	" 1 2 "	TERUG ←
- - -	" 1 "	" →
- - -	" 2 "	" →



ONTGRONDINGEN BIJ RETOURSTROMING

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A₄

WATERLOOPKUNDIG LABORATORIUM

M.1201- 1056

FIG.II-106

T2

Q = 50 l/s

HEEN : d = 60 cm t.o.v. VASTE BODEM
(m.p. 19,0)

TERUG : d = 60 cm (m.p. 2,5)

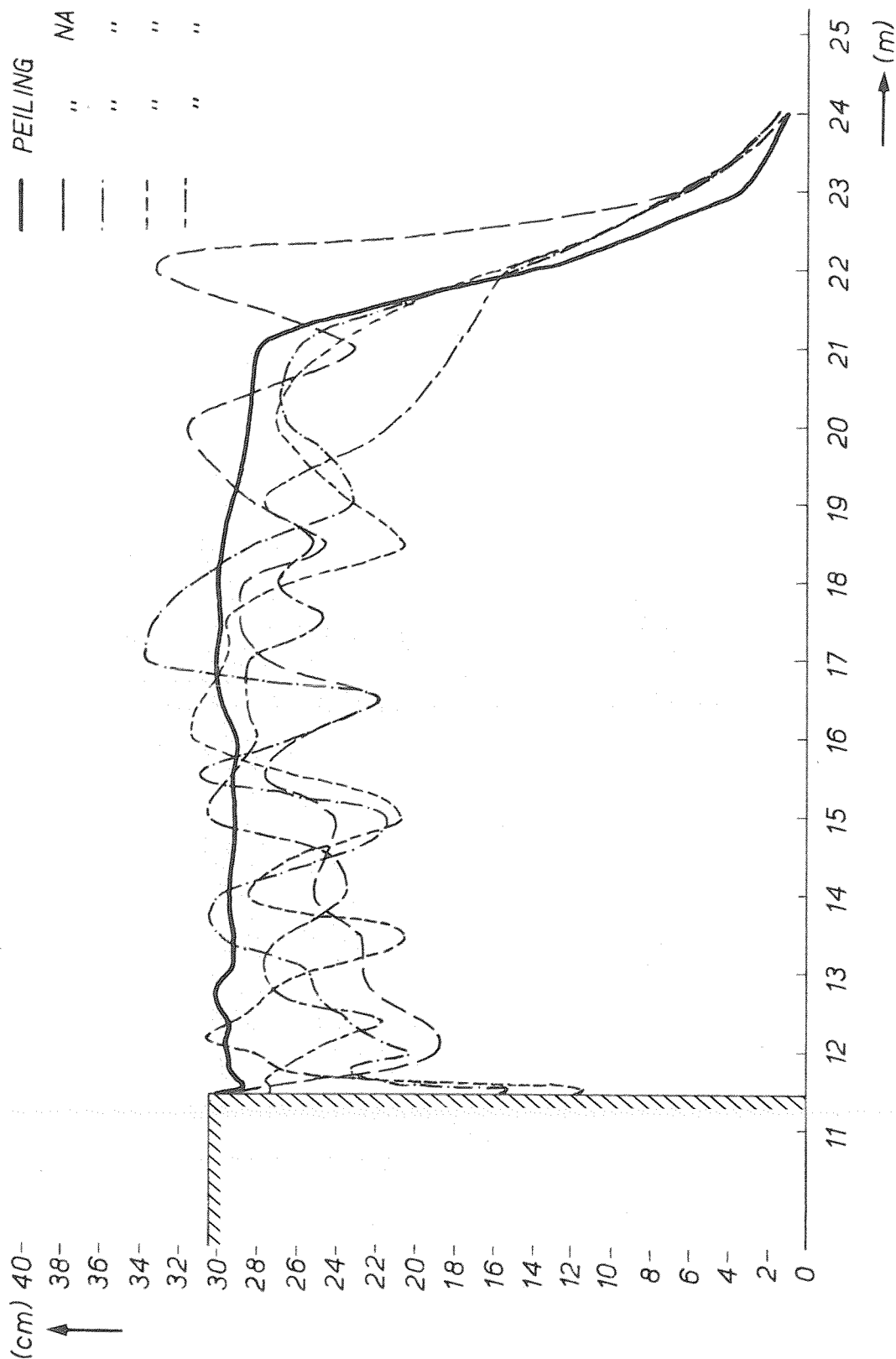
— PEILING 0 uur

— " NA 3 " HEEN →

— " " 1 " TERUG ←

— " " 2 " " →

— " " 3 " " →



ONTGRONDINGEN BIJ RETOOURSTROMING

WATERLOOPKUNDIG LABORATORIUM

K_M

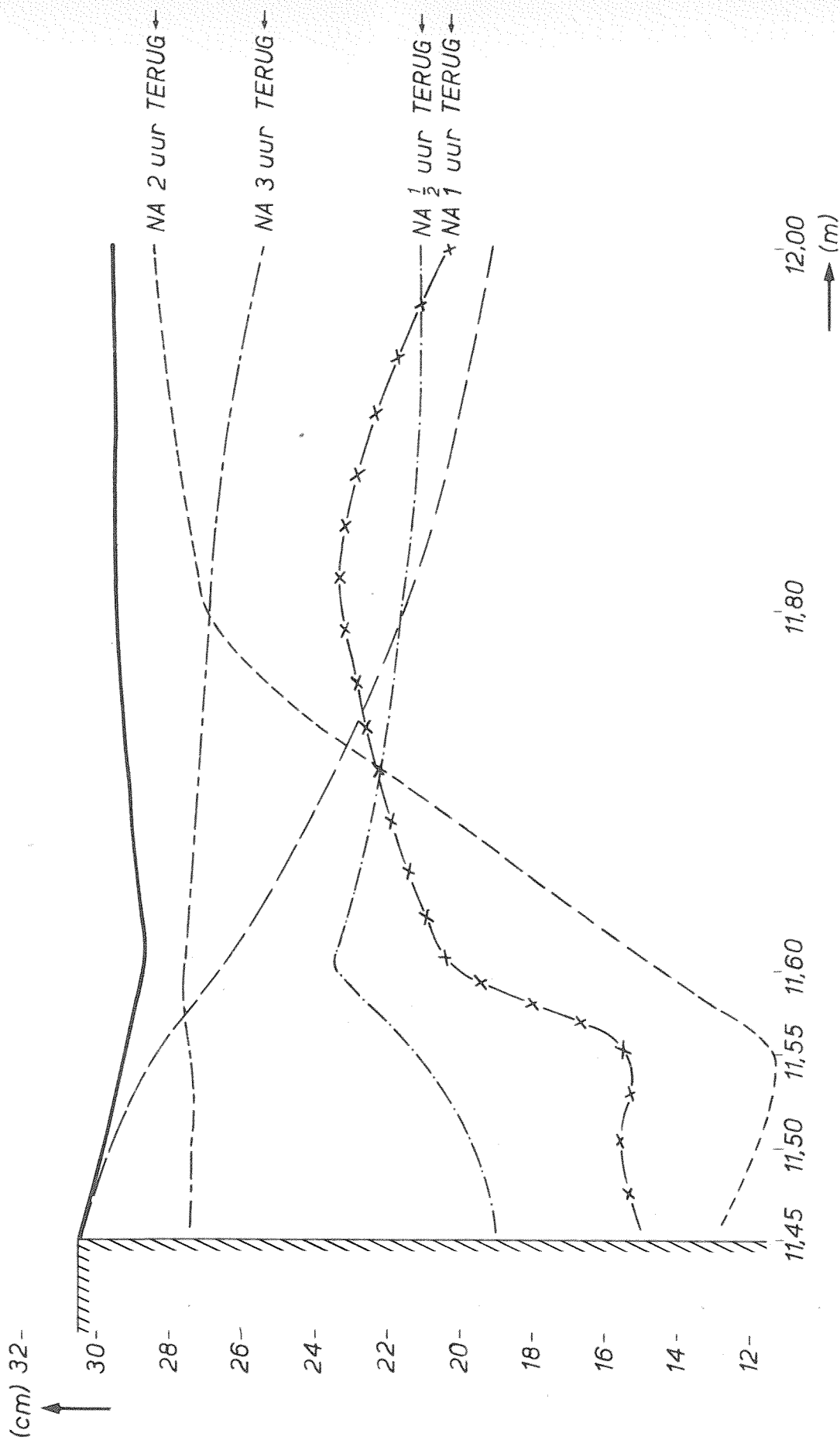
A₄

M.1201-1057

FIG. II-107

T2

— 0 uur
 - - - NA 3 " HEEN →
 - - - " 2 " TERUG ←
 50 l/s



ONTGRONDINGEN BIJ RETOURSTROMING

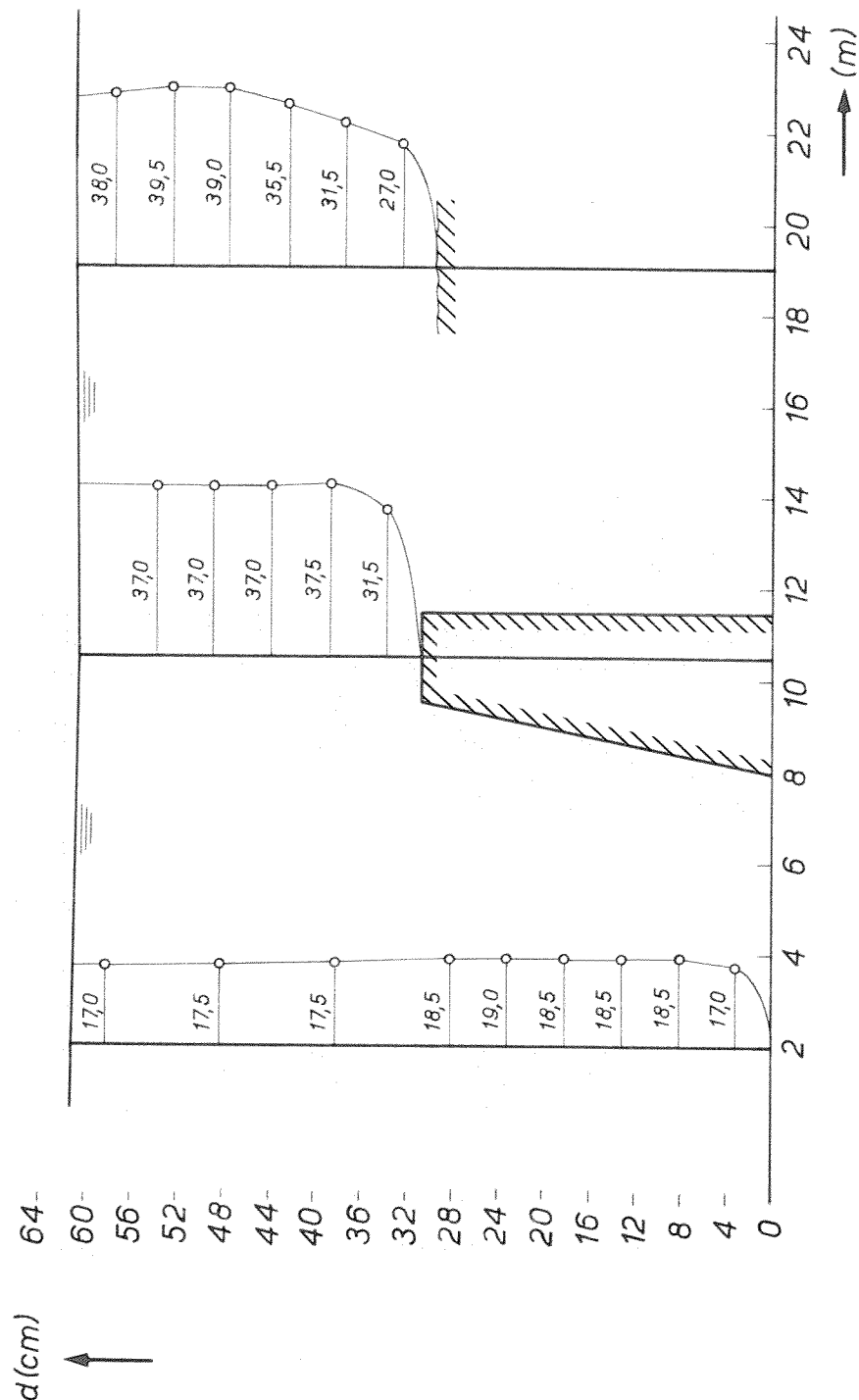
K_M

A4

WATERLOOPKUNDIG LABORATORIUM

M.1201-1058 FIG. II-108

T2 STROOMSNELHEDEN
 NA 1 uur HEEN
 $Q = 50 \text{ l/s}$



VERTIKALE SNELHEIDSVERDELINGEN

WATERLOOPKUNDIG LABORATORIUM

K_M

A4

M.1201-1059

FIG. II-109

T3

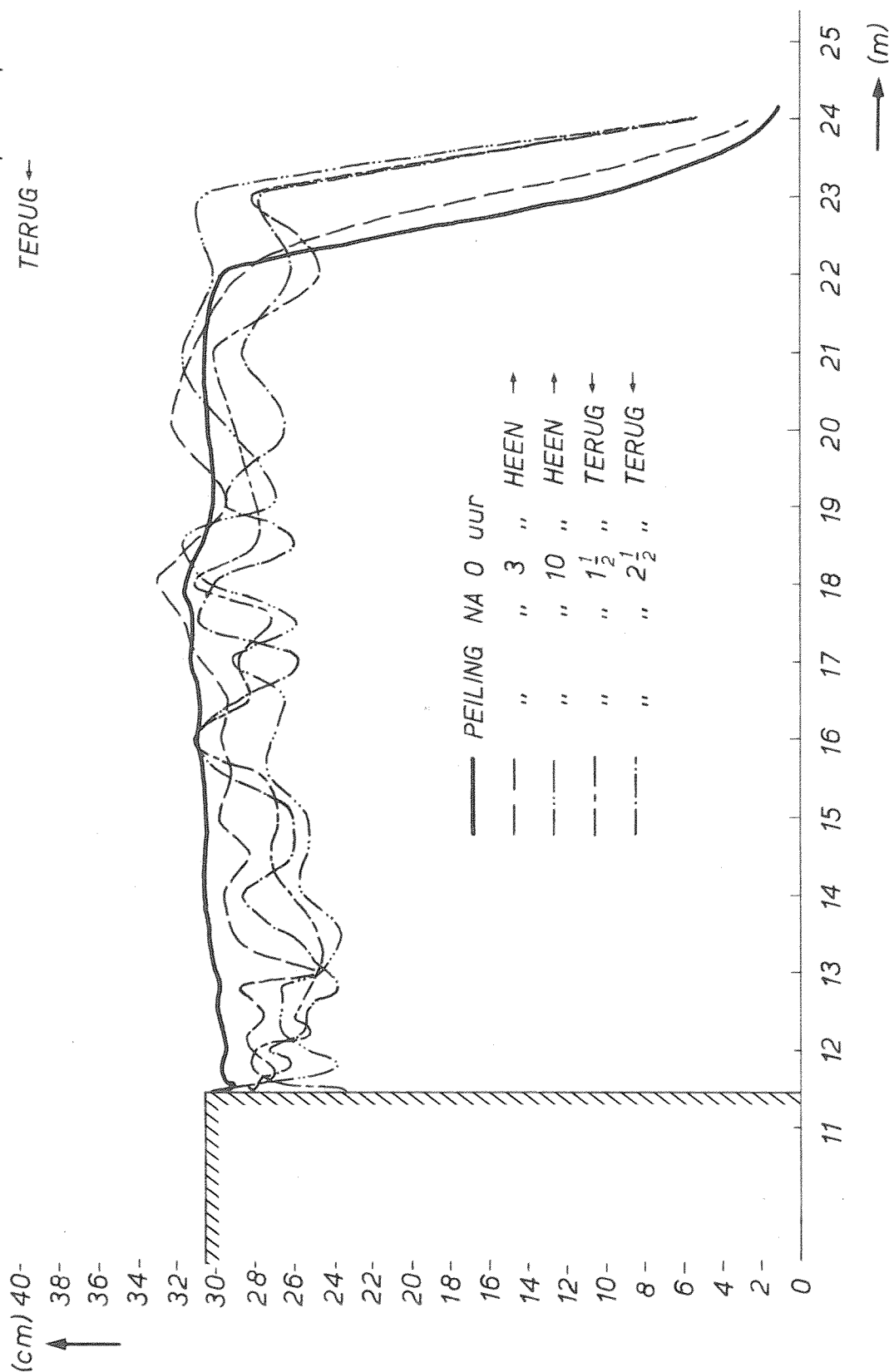
Q = 40 l/s

DIEPTE 60 cm t.p.v. m.p. 19 (AFL. 59,3)

HEEN →

60 cm t.p.v. m.p. 2 (AFL. 58,7)

TERUG ←



ONTGRONDINGEN BIJ RETOOURSTROMING

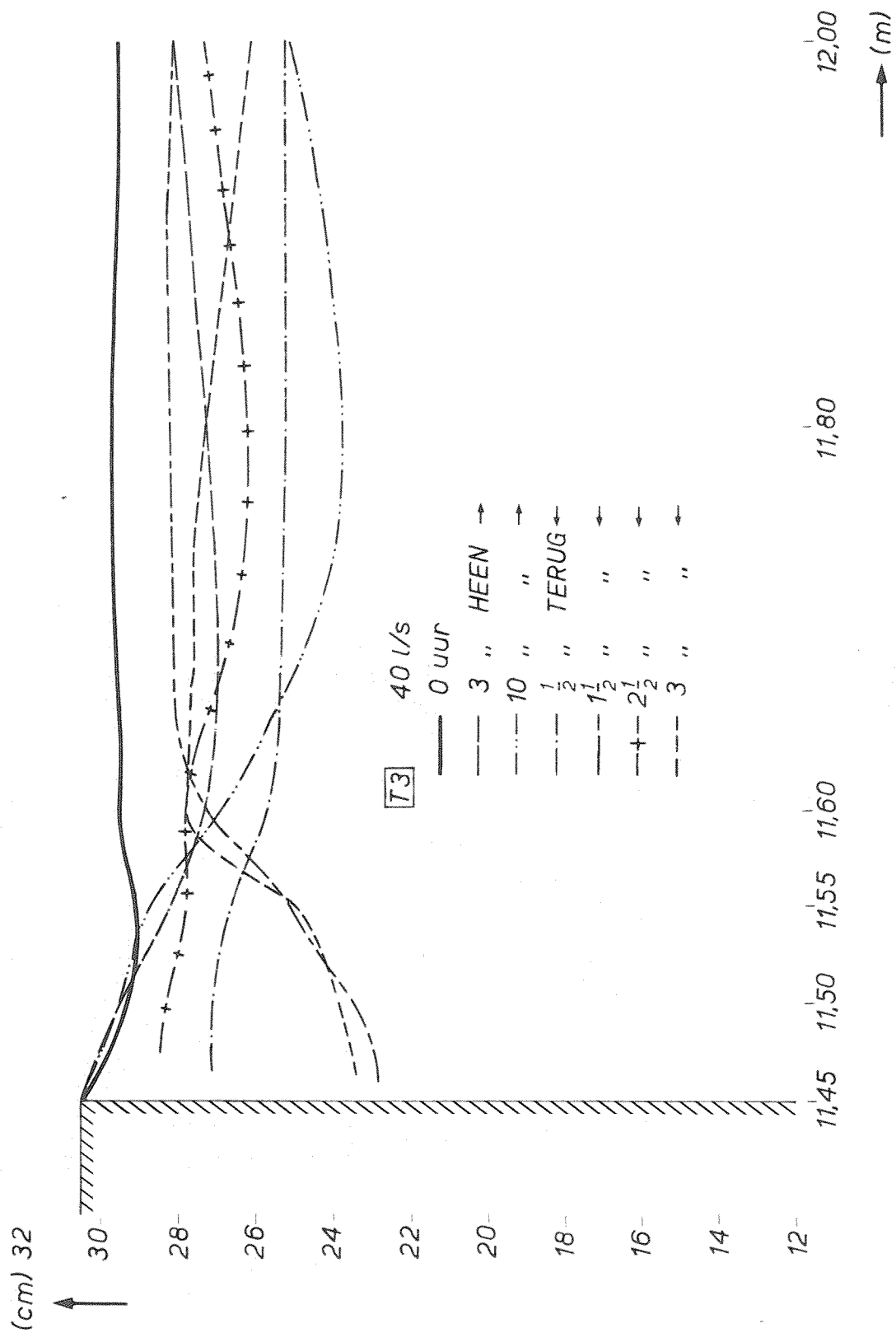
K_M

A4

WATERLOOPKUNDIG LABORATORIUM

M.1201-1060

FIG. II-110



ONTGRONDINGEN BIJ RETOURSTROMING

WATERLOOPKUNDIG LABORATORIUM

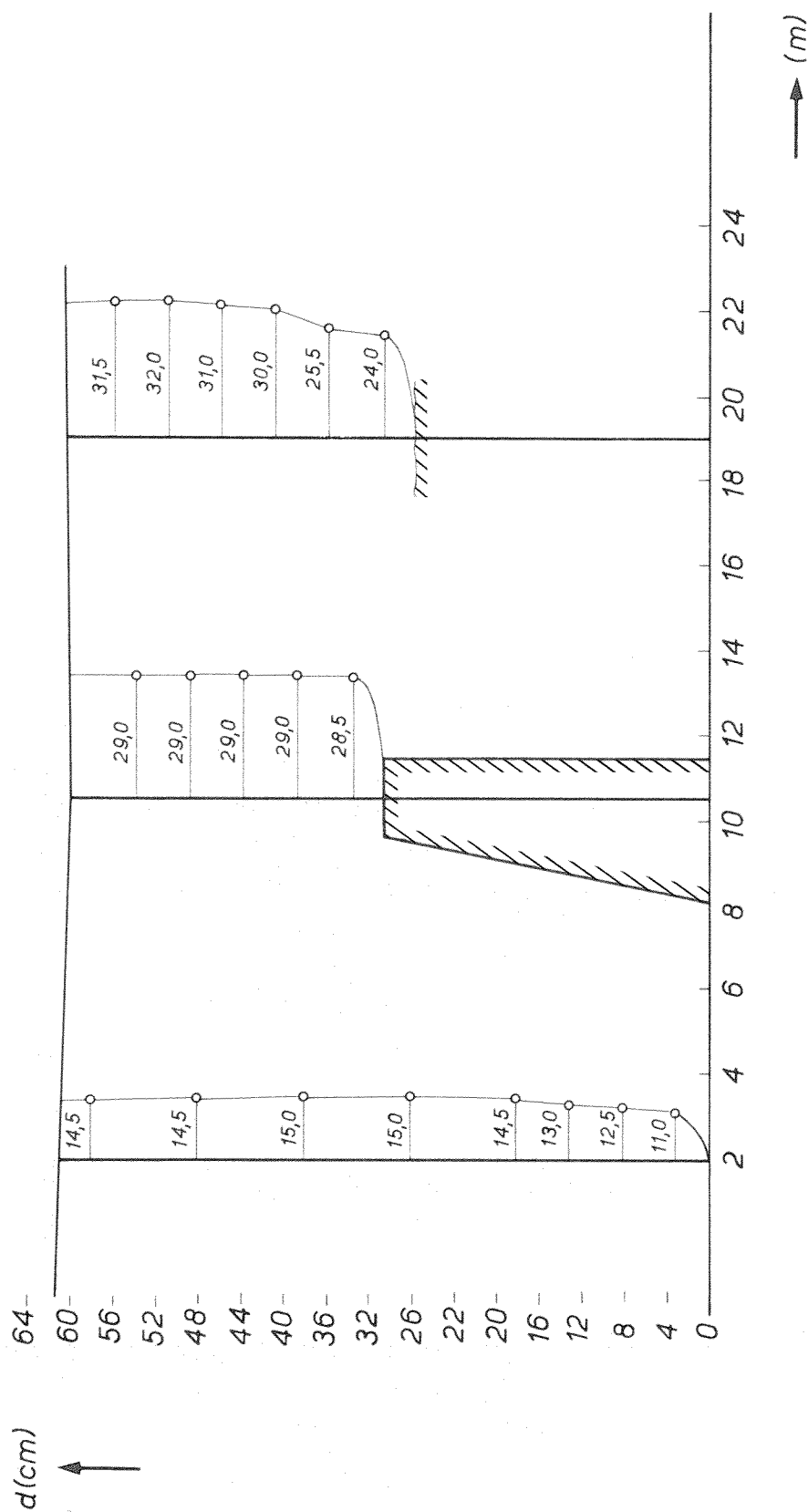
K_M

A4

M.1201-1061

FIG. II-111

T3 STROOMSNELHEDEN NA 9 uur
STROMEN (HEEN)

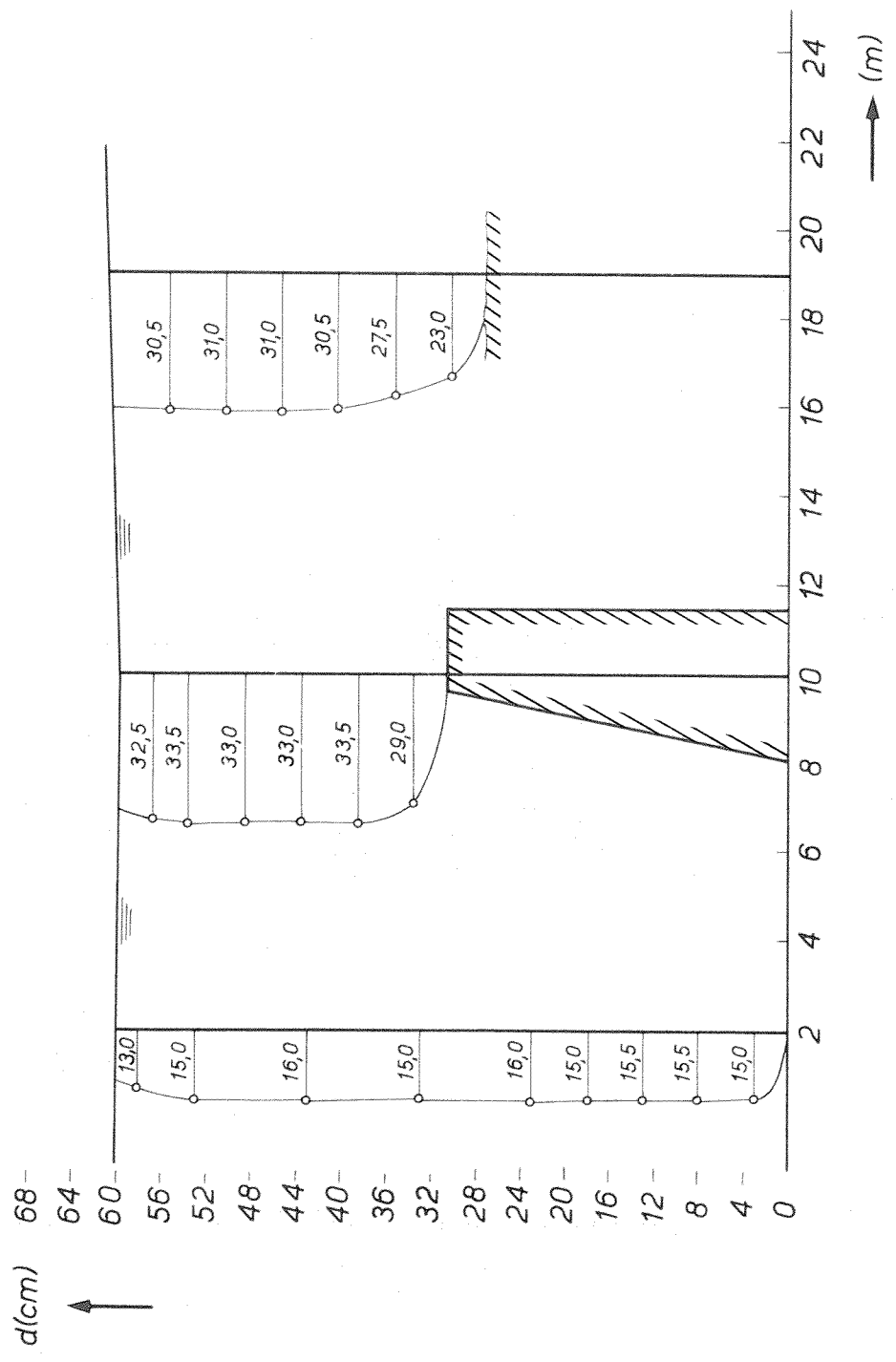


VERTIKALE SNELHEIDSVERDELINGEN

K_M

A4

T₃ STROOMSNELHEDEN
 NA 3 uur STROMEN (TERUG)
 Q = 40 l/s



VERTIKALE SNELHEIDSVERDELINGEN

K_M

A4

waterloopkundig laboratorium postbus 177 delft