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NOMOGRAM FOR THE WIDTH OF AN ESCAPE ROUTE BORDERED BY A WIRED GLASS SCREEN

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SUMMARY

A nomogram for the width of escape routes bordered by wired glass screens is given and the method of calculation is described.

KEY WORDS: Building, escape means, glazing-wired, movement, radiation, safety.

MINISTRY OF TECHNOLOGY AND FIRE OFFICES' COMMITTEE
JOINT FIRE RESEARCH ORGANIZATION

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1. Introduction

A recent report[1] discusses the radiation likely to be transmitted by a 6 mm ($\frac{1}{4}$ in) wired glass screen separating a fire from an escape route and the danger of people being burnt as they pass the screen. This note describes a nomogram for determining the width of such escape routes, based on the earlier discussion.

A wired glass screen, depending on its design and constructional materials, can provide up to 1 hour's fire resistance. However the escape route width should be related to the expected fire severity and not necessarily to the fire resistance requirements for the building.

2. Basis for Nomogram

It is assumed that the wired glass screen, during the early stages of the fire, radiates an intensity of 2.0 W/cm^2 if the fire becomes as severe as a $\frac{1}{2}$ hour fire resistance test and 4.0 W/cm^2 if the fire becomes more severe.

The intensity of radiation which a person can bear on his skin is shown below for different exposure times[2, 3].

Table 1

Intensity of radiation for unbearable pain

Exposure time t - s	Intensity of radiation I - W/cm^2	Necessary configuration factor - ϕ lower intensity fire	 higher intensity fire
5	0.92	0.46	0.23
10	0.56	0.28	0.14
20	0.36	0.18	0.09
30	0.28	0.14	0.07
40	0.24	0.12	0.06
50	0.20	0.10	0.05

The configuration factor, ϕ, is defined by

$$I = \phi \, I_o$$

where I is the intensity at a distance S from the screen

and I_o is the intensity radiated by the screen

However[4], ϕ depends only on two quantities, N and the ratio of S to D, ...,

where D = height of screen

and $N = \dfrac{\text{length of screen}}{\text{height of screem}}$

The relationships between S/D, N and exposure time t are shown in Figs 1 and 2 for the higher and lower intensity fires.

The curves of Figs 1 and 2 can be represented approximately by:

$$\frac{S}{D} = 0.52 \, t^{0.43} \, N^{0.41} \quad \text{for the higher intensity fire} \qquad (1)$$

$$\frac{S}{D} = 0.34 \, t^{0.43} \, N^{0.36} \quad \text{for the lower intensity fire} \qquad (2)$$

These approximations are also shown in Figs 1 and 2. They have been chosen to err on the side of safety, i.e. they tend to over-estimate the distance at which the critical intensity of radiation is received. In view of this, and of other assumptions[1], it is reasonable to take S as the total width of the escape route.

To construct the nomogram, equations (1) and (2) have been rewritten as determinants[5].

Higher intensity fire: $\begin{vmatrix} +1 & 0.41 \log 0.52N & 1 \\ 0 & \frac{1}{2} \log S/D & 1 \\ -1 & 0.43 \log t & 1 \end{vmatrix} = 0$

Lower intensity fire: $\begin{vmatrix} +1 & 0.36 \log 0.34N & 1 \\ 0 & \frac{1}{2} \log S/D & 1 \\ -1 & 0.43 \log t & 1 \end{vmatrix} = 0$

The nomogram is given in Fig 3.

3. Worked example

An escape route is bordered by a wired glass screen 1.5 m high and 6.0 m long. What is the safe width of the route for a person moving at an average speed of 2.0 m/s if a lower intensity fire is expected?

$$\text{Exposure time} = \frac{6.0}{2.0} = 3 \text{ s}$$

$$N = \frac{6.0}{1.5} = 4.0$$

Drawing a line on the nomogram from N = 4 on the left-hand side of the N - scale to t = 3.0 on the t-scale gives an intersection of

$S/D \simeq 0.9$ on the S/D-scale

i.e. $S = 0.9 \times D = 0.9 \times 1.5 \text{ m} = 1.35 \text{ m}$

The safe width of the escape route is 1.35 m.

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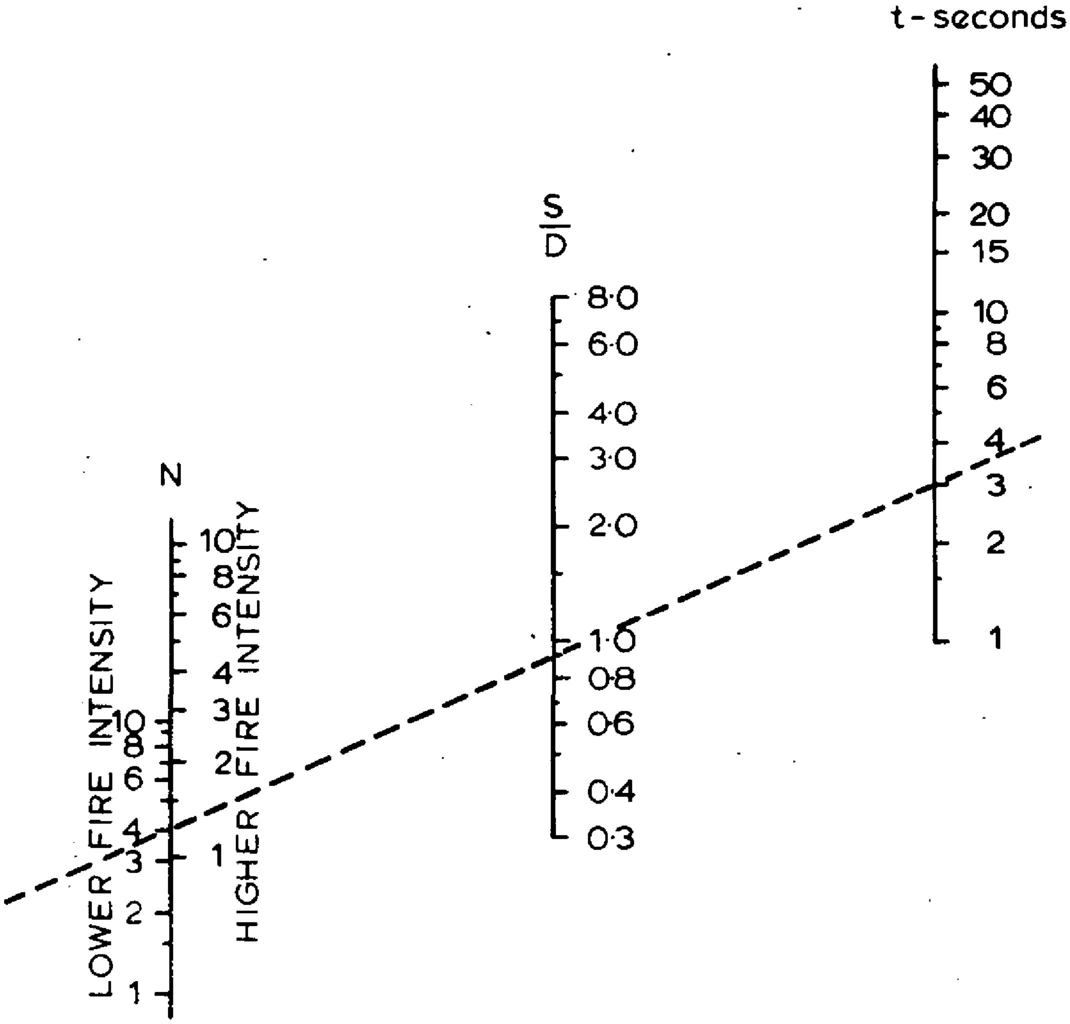

$N = \dfrac{\text{length of screen}}{\text{height of screen}}$

$\dfrac{S}{D} = \dfrac{\text{width of escape route}}{\text{height of screen}}$

t = exposure time in seconds

FIG. 3. NOMOGRAM FOR MINIMUM WIDTH OF ESCAPE ROUTE BORDERED BY A WIRED-GLASS SCREEN

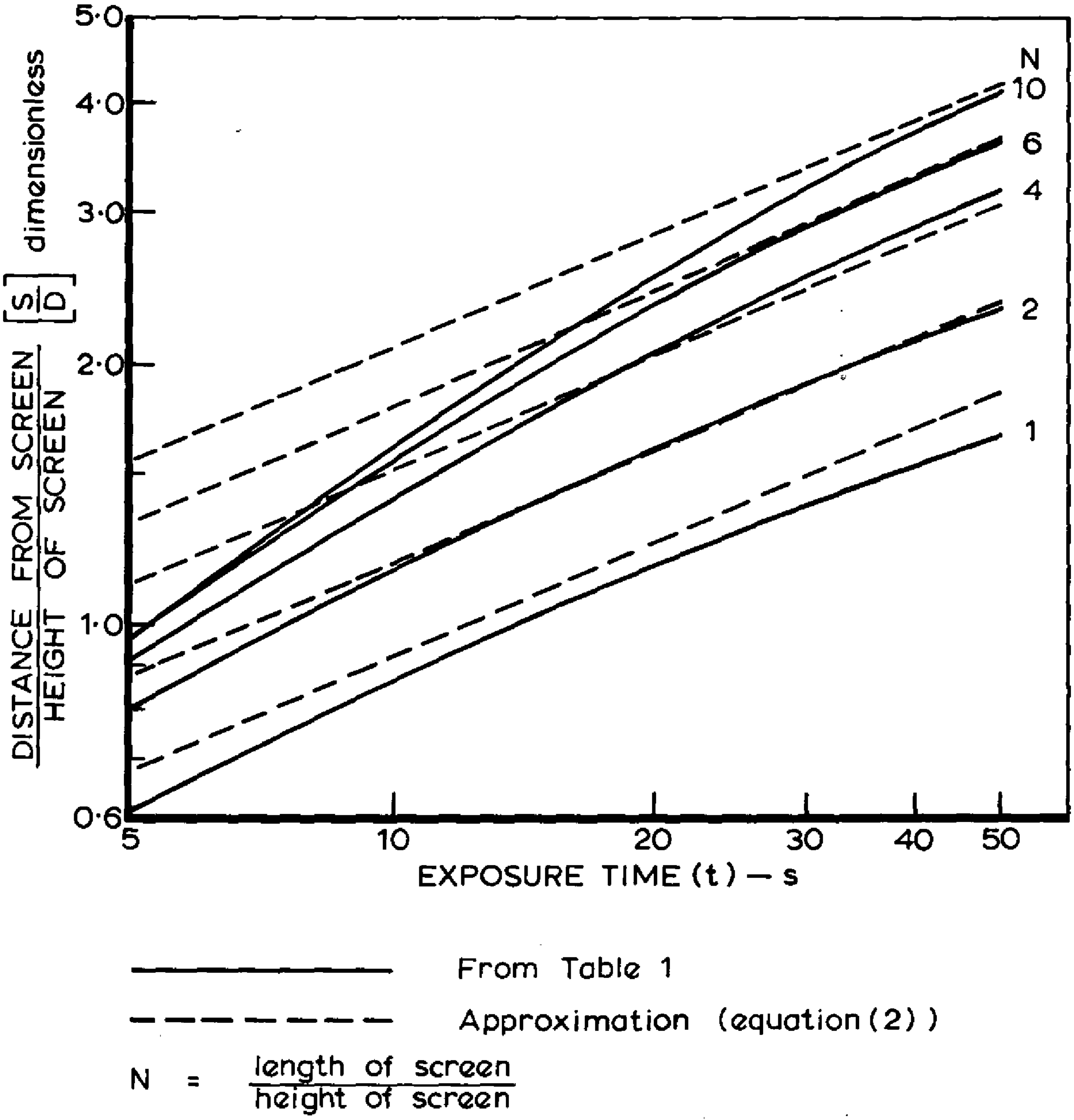

FIG. 2. SAFE DISTANCE FROM WIRED-GLASS SCREEN AND LOWER INTENSITY FIRE

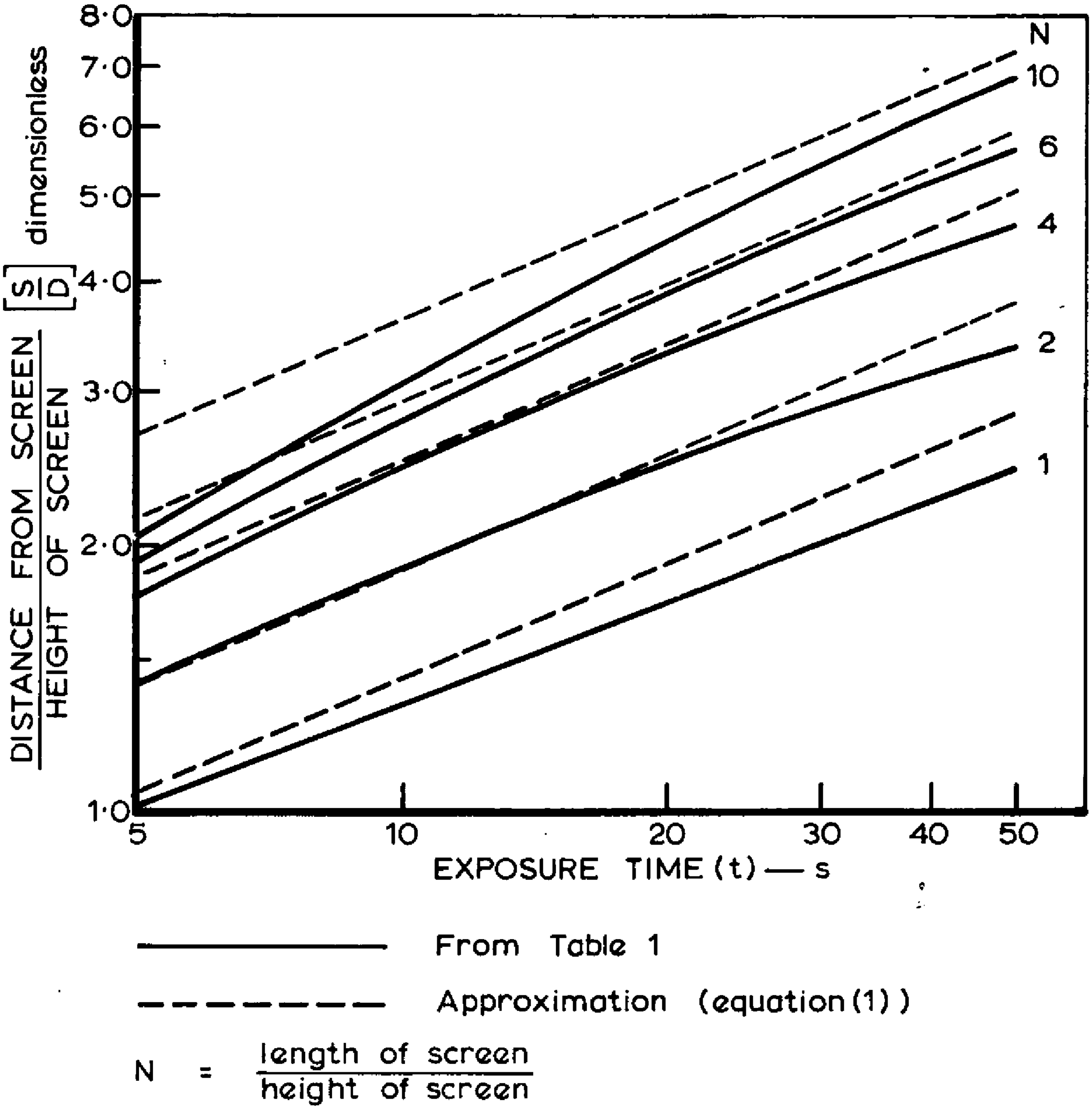

FIG. 1. SAFE DISTANCE FROM WIRED-GLASS SCREEN AND HIGHER INTENSITY FIRE