

Thesis Presented to the University of Edinburgh

for

the Degree of the Doctor of Philosophy in the

Department of Engineering

VOL. II

ON THE STRENGTH OF COLUMNS

by

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B.E. (BOM.)

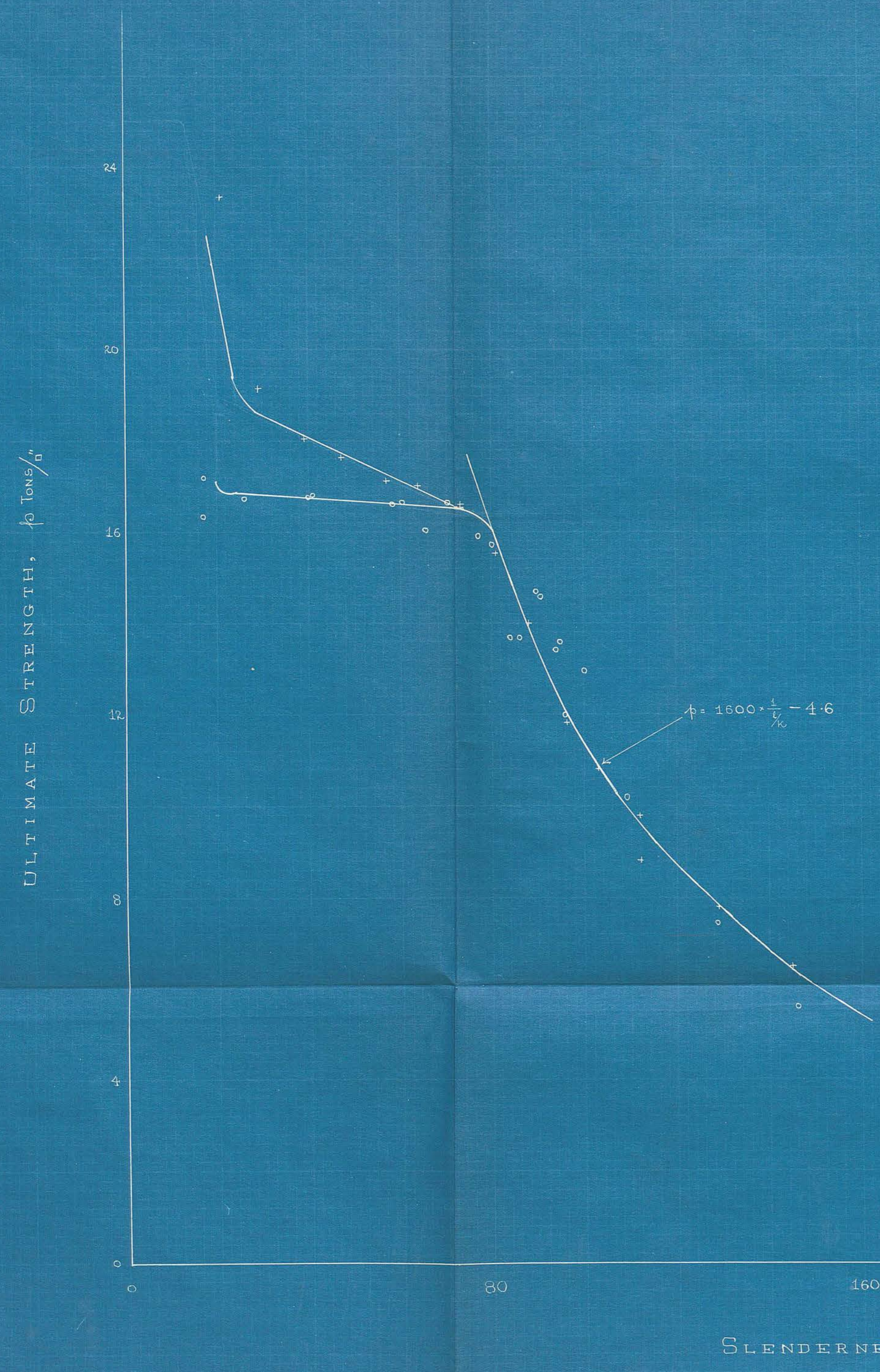
Engineering Laboratory, }
University of Edinburgh, 1927. }




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STRENGTH OF COLUMNS.



MATERIAL-----W.I.
 ENDS-----FREE
 SECTION-----

LILLY-----+
 ROBERTSON-----o

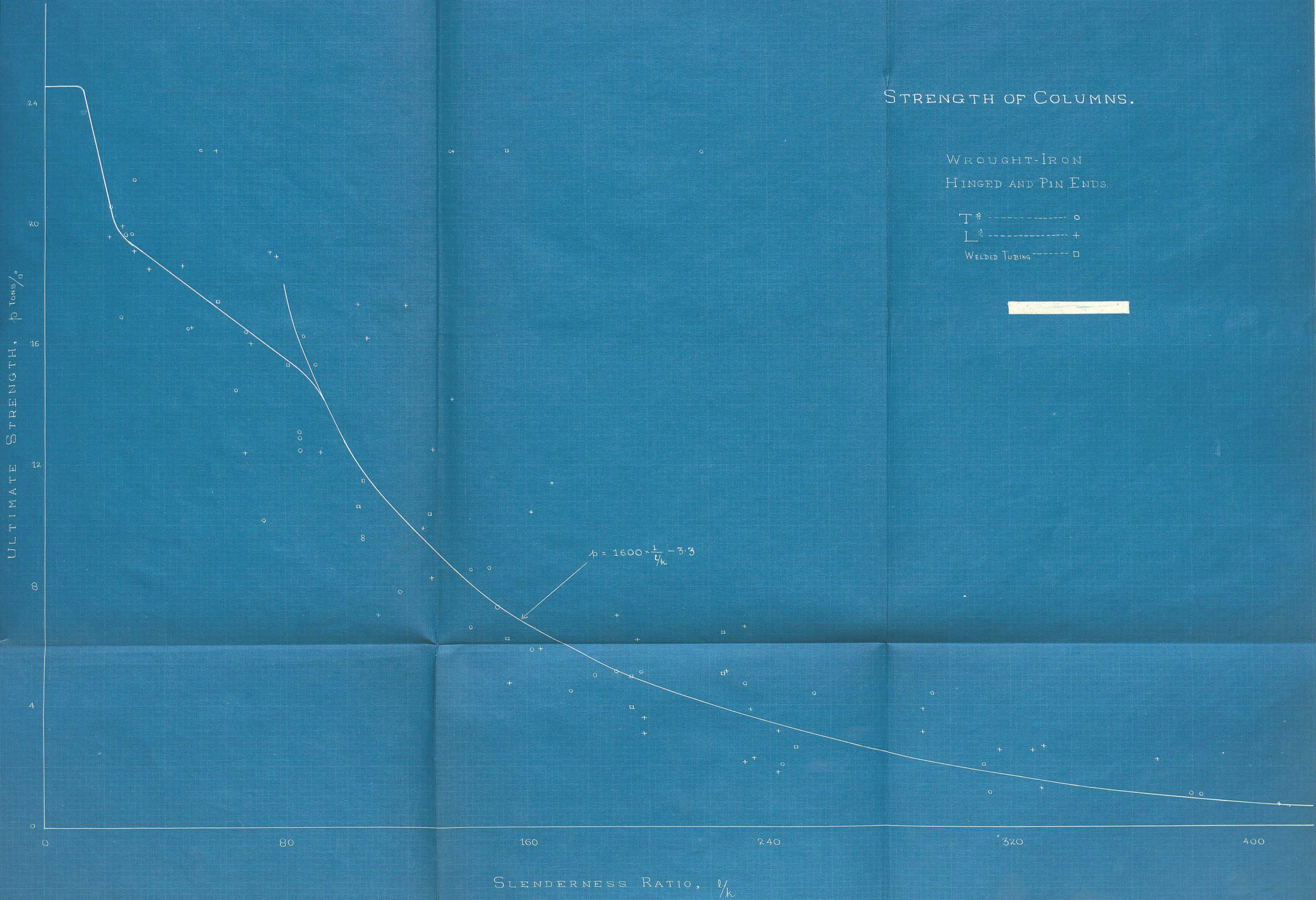


SLENDERNES RATIO, l/k

STRENGTH OF COLUMNS.

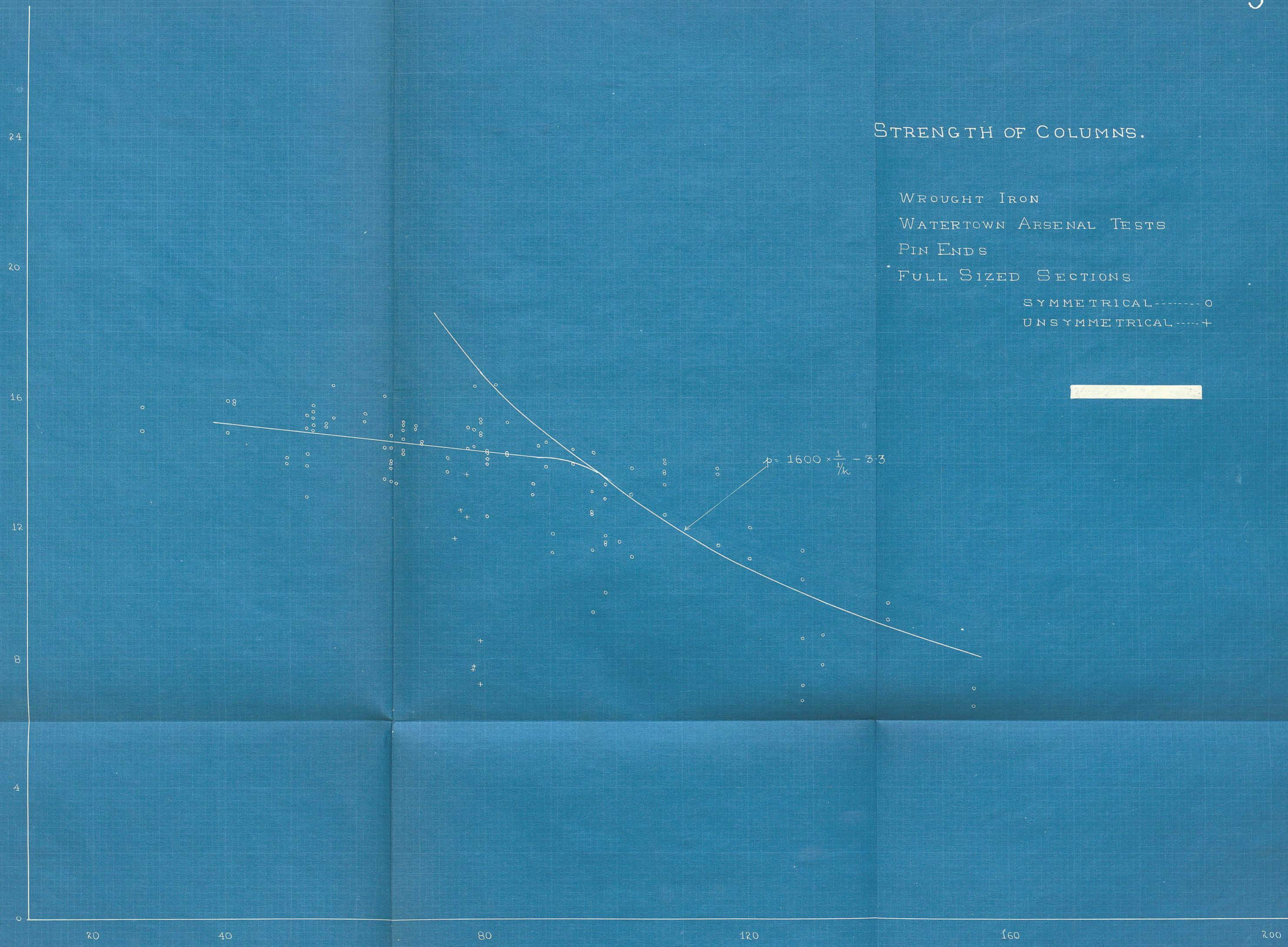
WROUGHT-IRON
HINGED AND PIN ENDS.

- T # ----- ○
- L # ----- +
- WELDED TUBING ----- □



STRENGTH OF COLUMNS.

ULTIMATE STRENGTH, p Tons/ in^2



WROUGHT IRON
 WATERTOWN ARSENAL TESTS
 PIN ENDS
 FULL SIZED SECTIONS
 SYMMETRICAL-----o
 UNSYMMETRICAL-----+

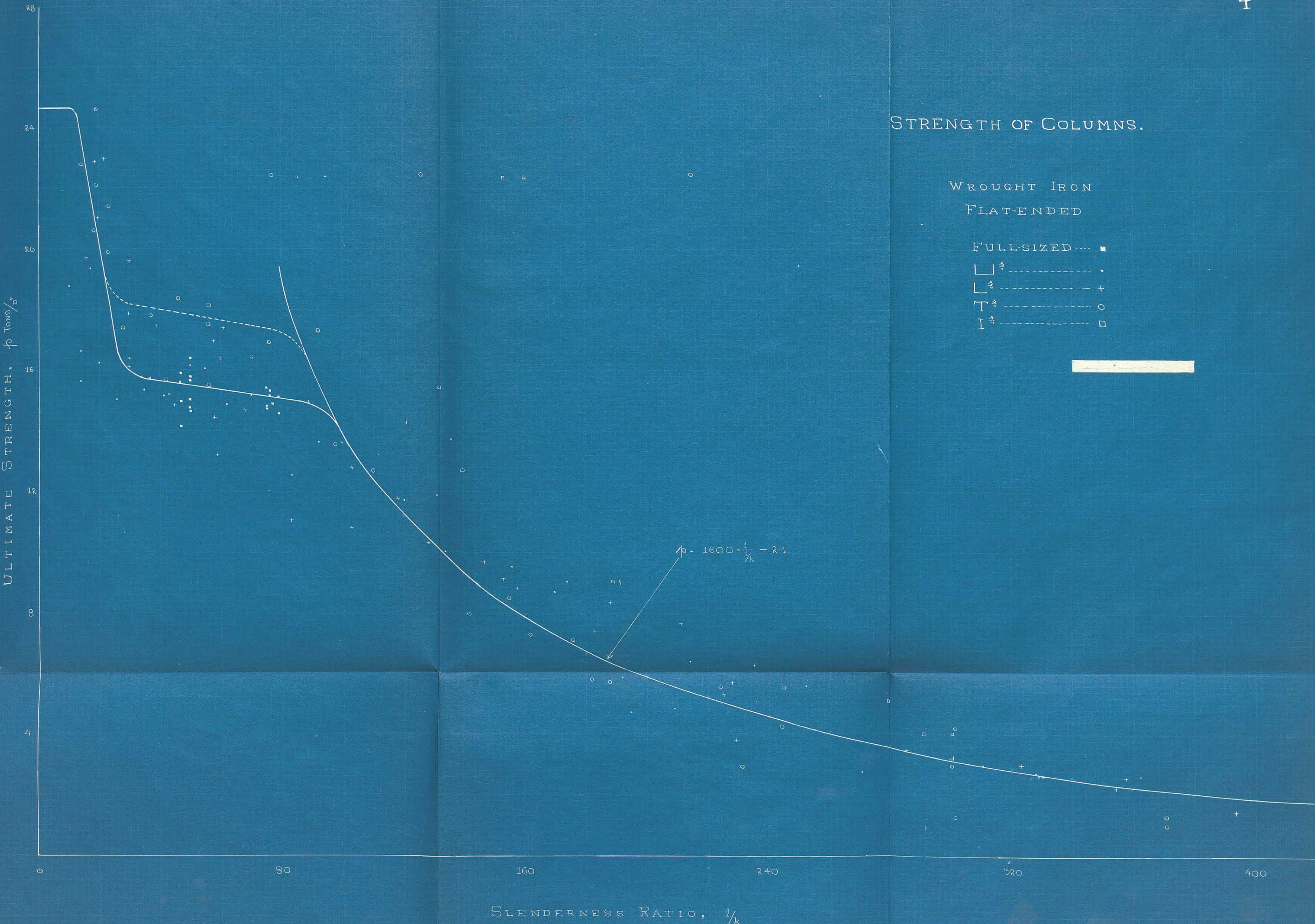
$$p = 1600 \times \frac{1}{l/k} - 3.3$$

SLENDERNESS RATIO, l/k

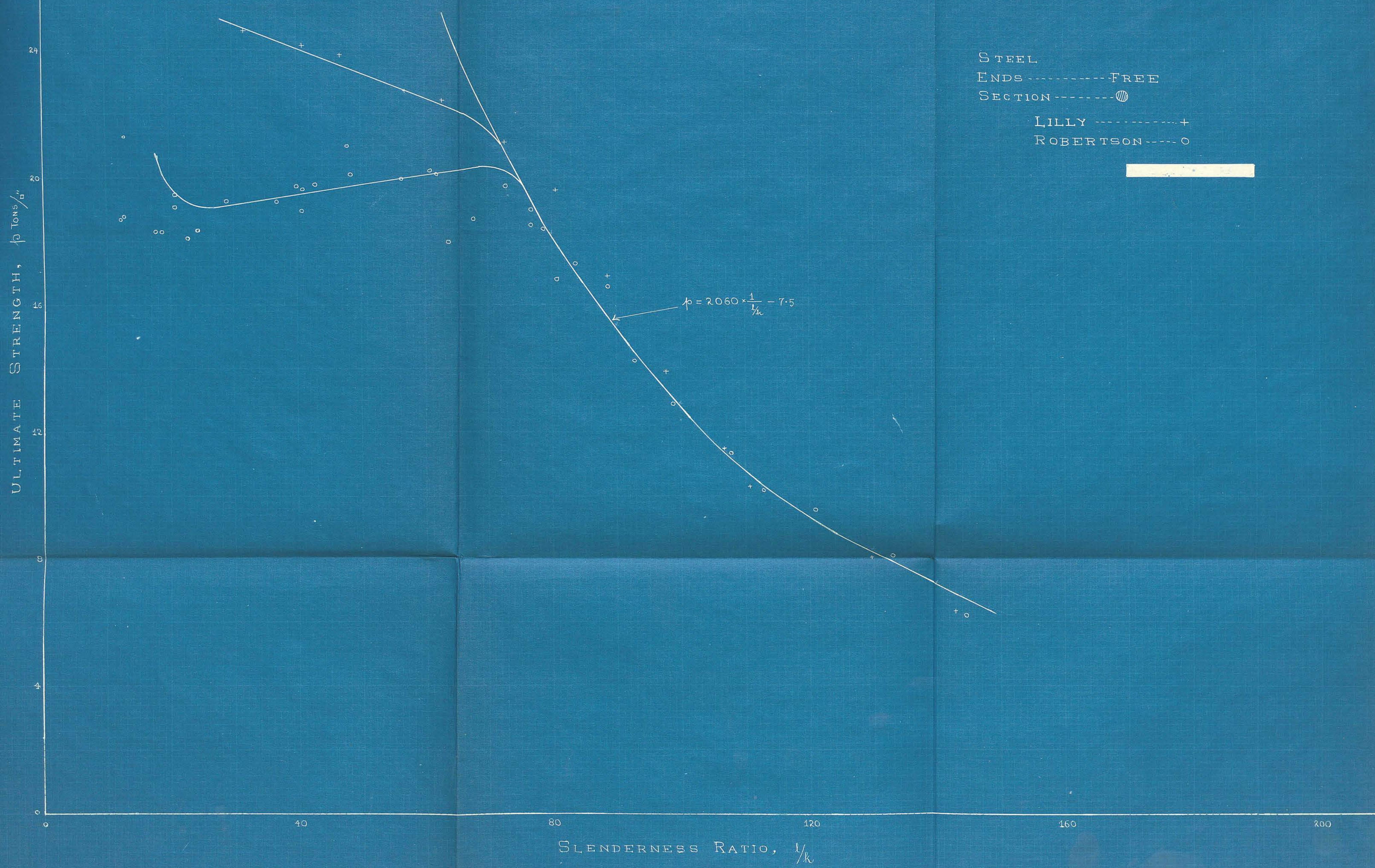
STRENGTH OF COLUMNS.

WROUGHT IRON
FLAT-ENDED

- FULL-SIZED ---- ■
- $\square^{\frac{3}{4}}$ ----- .
- $\square^{\frac{1}{2}}$ ----- +
- $T^{\frac{3}{4}}$ ----- ○
- $I^{\frac{3}{4}}$ ----- □



STRENGTH OF COLUMNS.



STRENGTH OF COLUMNS.

WATERTOWN ARSENAL

LAP WELDED STEEL TUBING

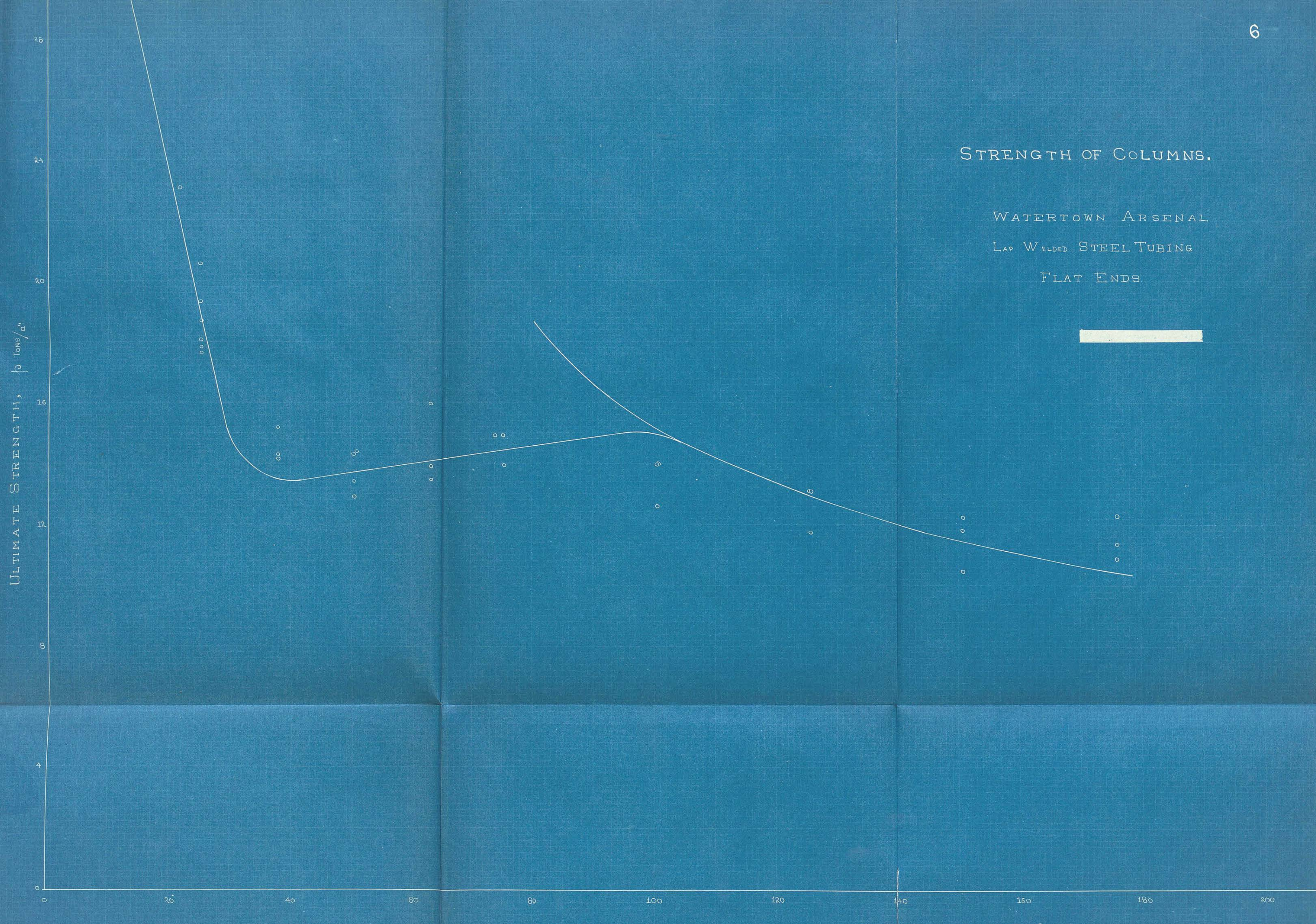
FLAT ENDS

ULTIMATE STRENGTH, p TONS/ in^2

28
24
20
16
12
8
4
0

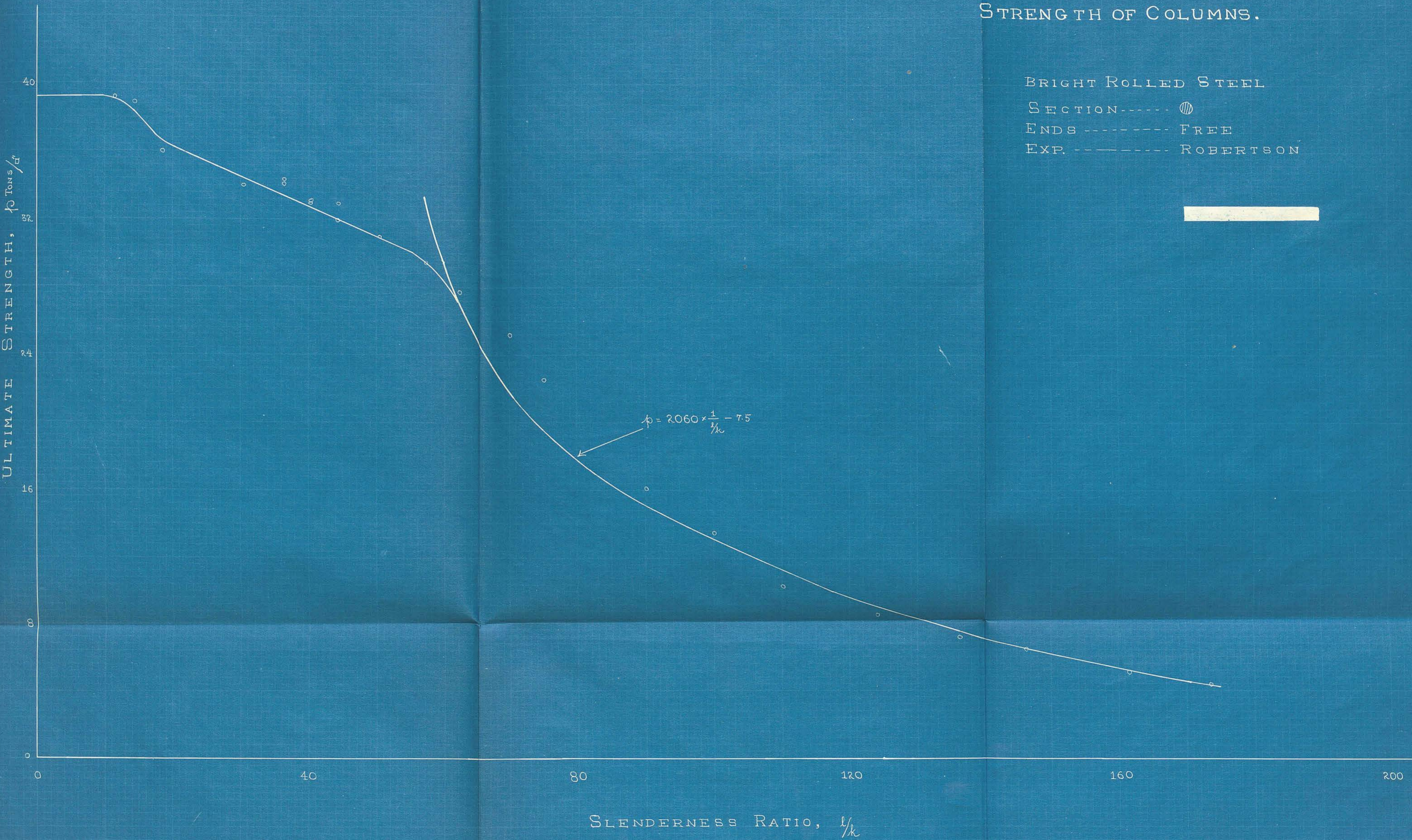
SLENDERNESS RATIO, l/k

20 40 60 80 100 120 140 160 180 200



STRENGTH OF COLUMNS.

BRIGHT ROLLED STEEL
 SECTION ----- \odot
 ENDS ----- FREE
 EXP. ----- ROBERTSON



STRENGTH OF COLUMNS.

CAST IRON

SECTION \bullet

ROUND ENDS

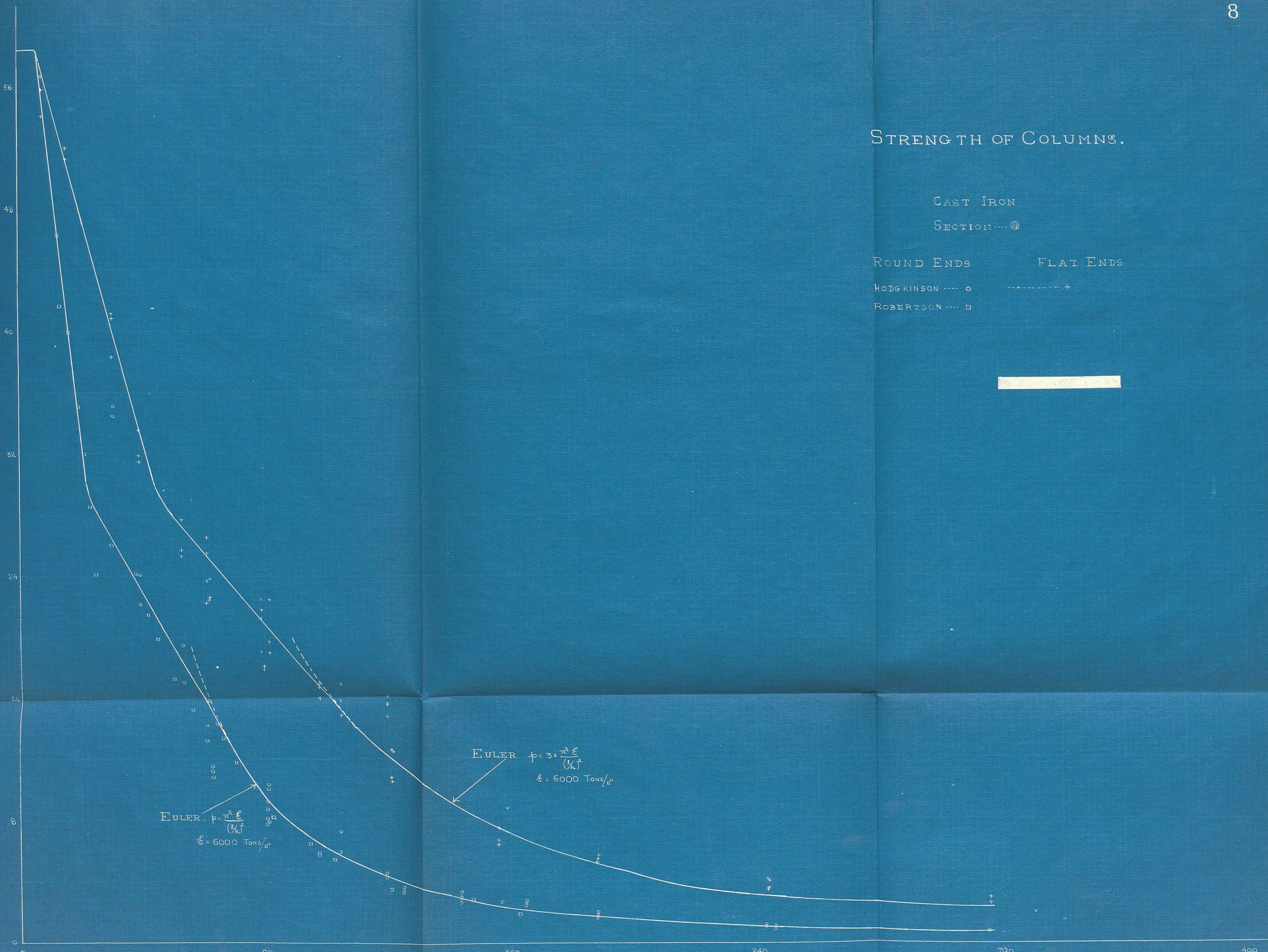
FLAT ENDS

HODGKINSON \circ

\circ

ROBERTSON \square

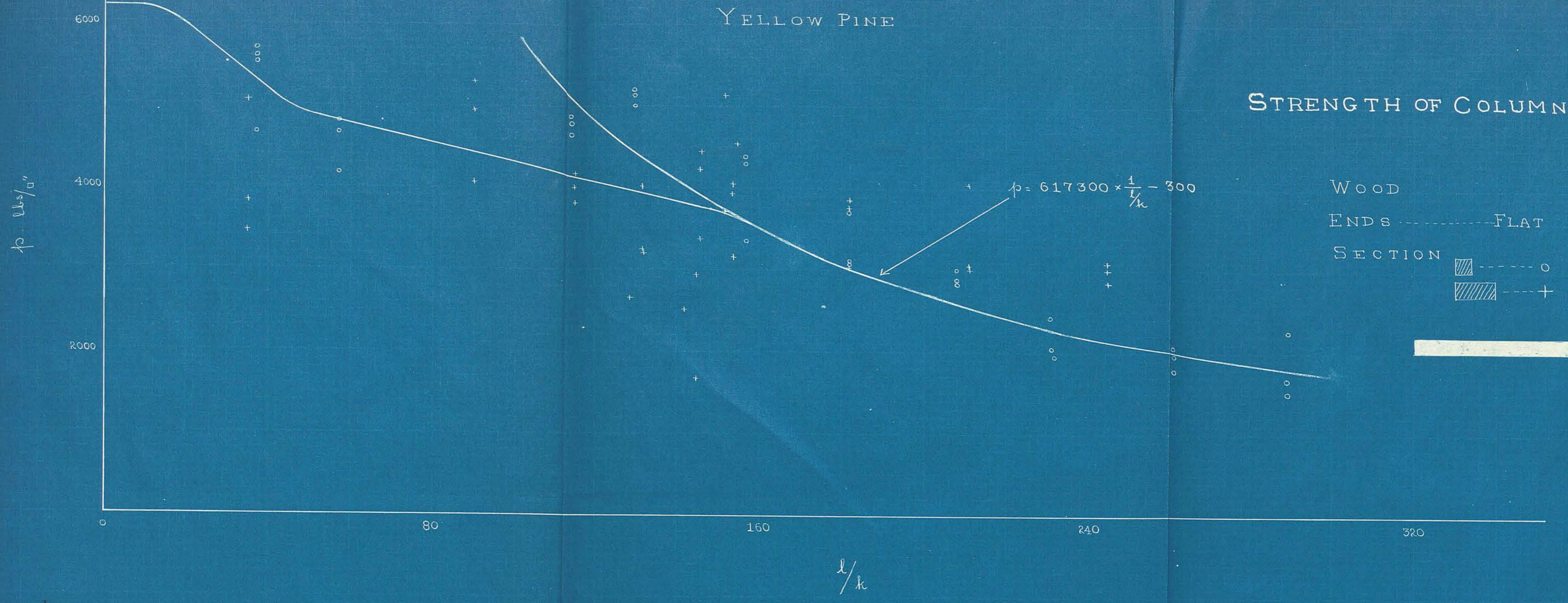
ULTIMATE STRENGTH, P_{Tons}/d^2



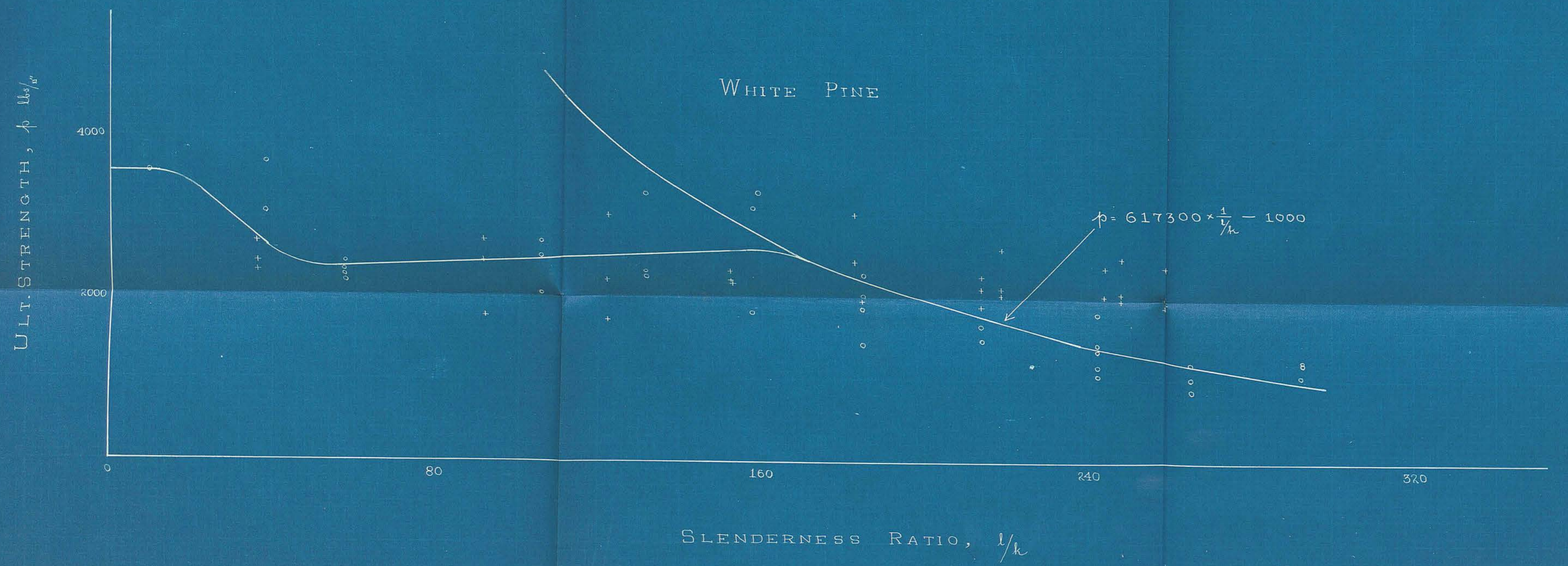
SLENDERNESS RATIO, l/k

YELLOW PINE

STRENGTH OF COLUMNS.



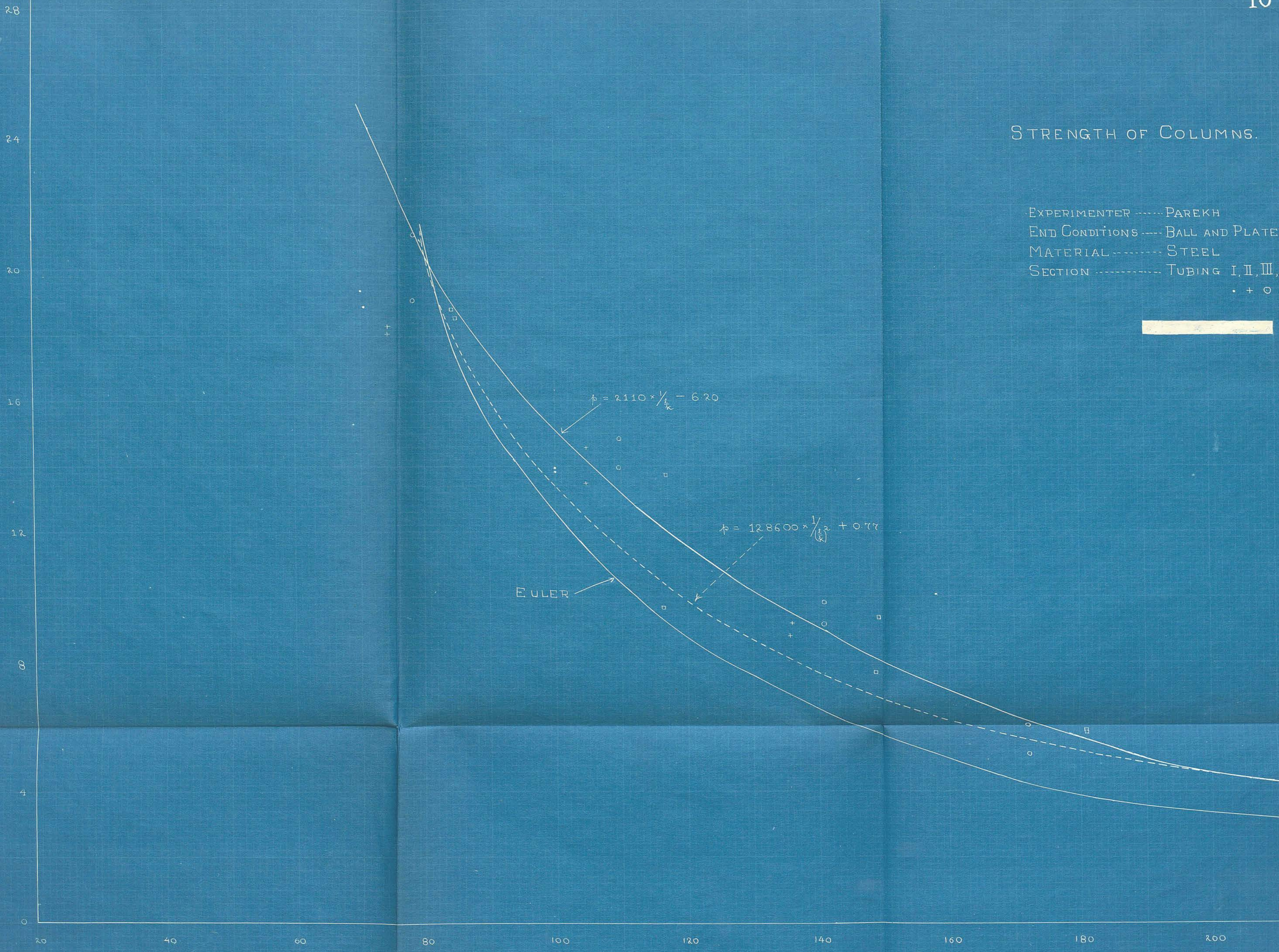
WHITE PINE



STRENGTH OF COLUMNS.

ULTIMATE STRENGTH, p TONS/IN²

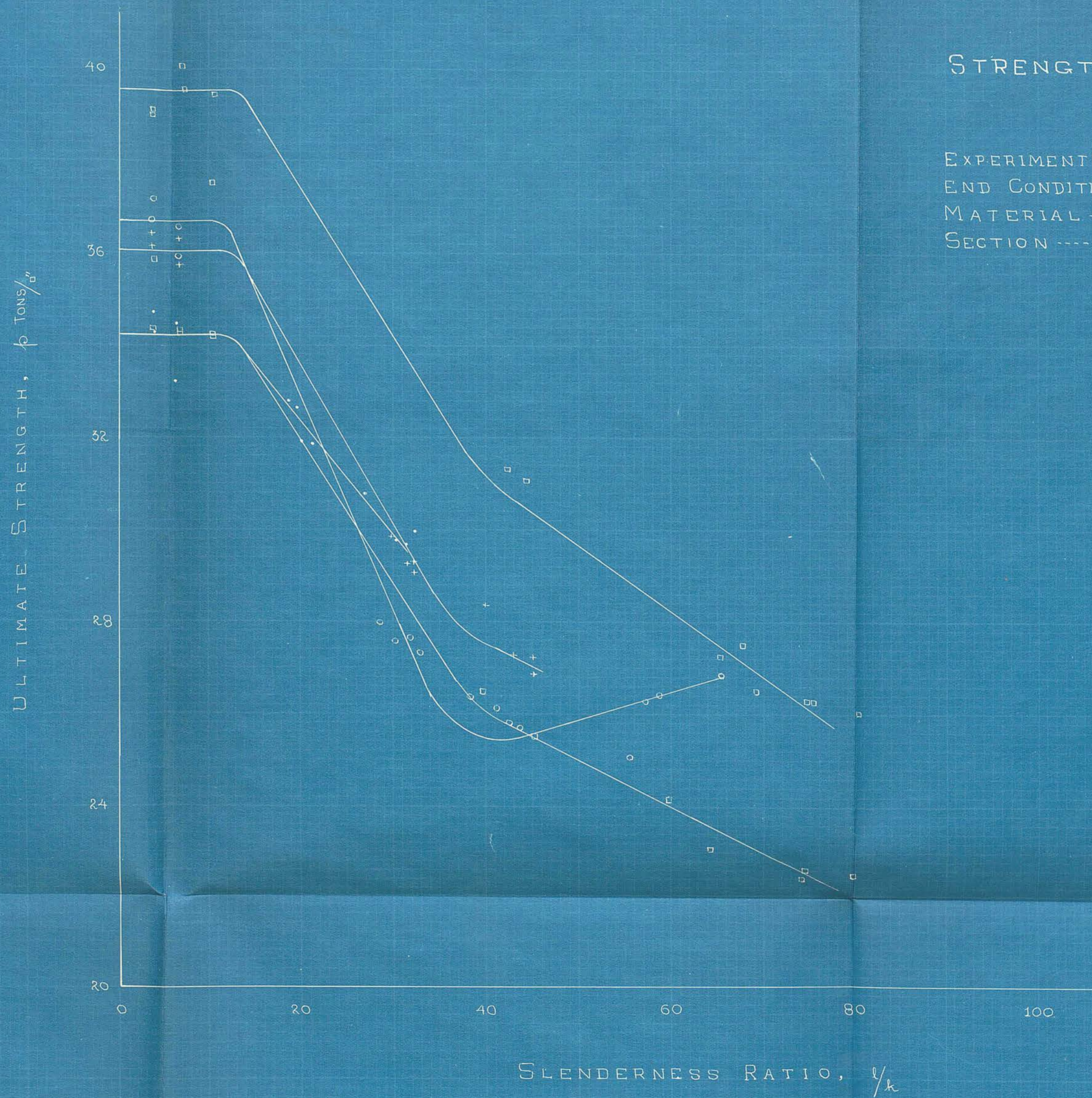
EXPERIMENTER ----- PAREKH
 END CONDITIONS ----- BALL AND PLATE
 MATERIAL ----- STEEL
 SECTION ----- TUBING I, II, III, IV
 . + o □



SLENDERNESS RATIO, l/k

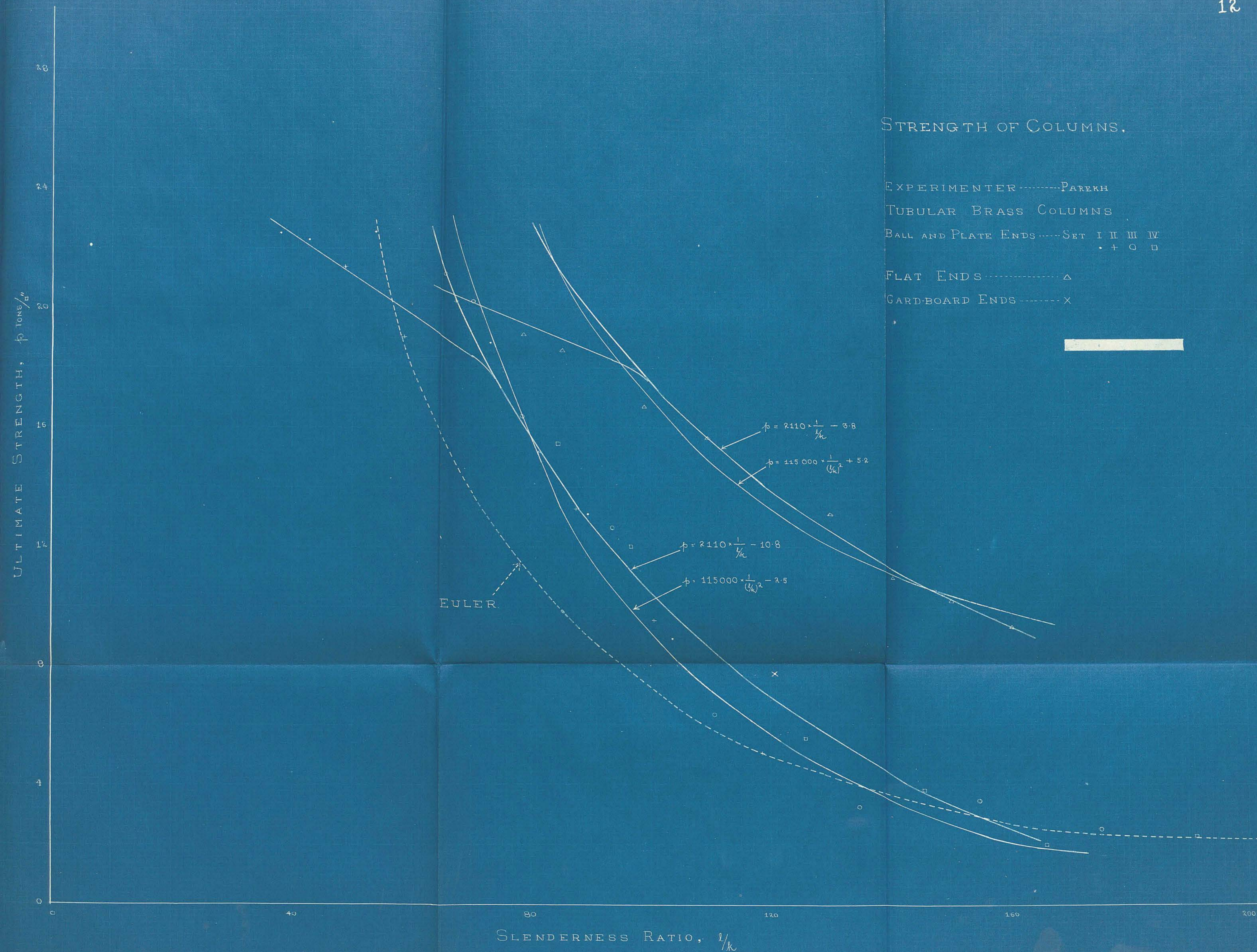
STRENGTH OF COLUMNS.

EXPERIMENTER ----- PAREKH
 END CONDITIONS ----- FLAT
 MATERIAL ----- STEEL
 SECTION ----- TUBING I II III IV
 . + ○ □

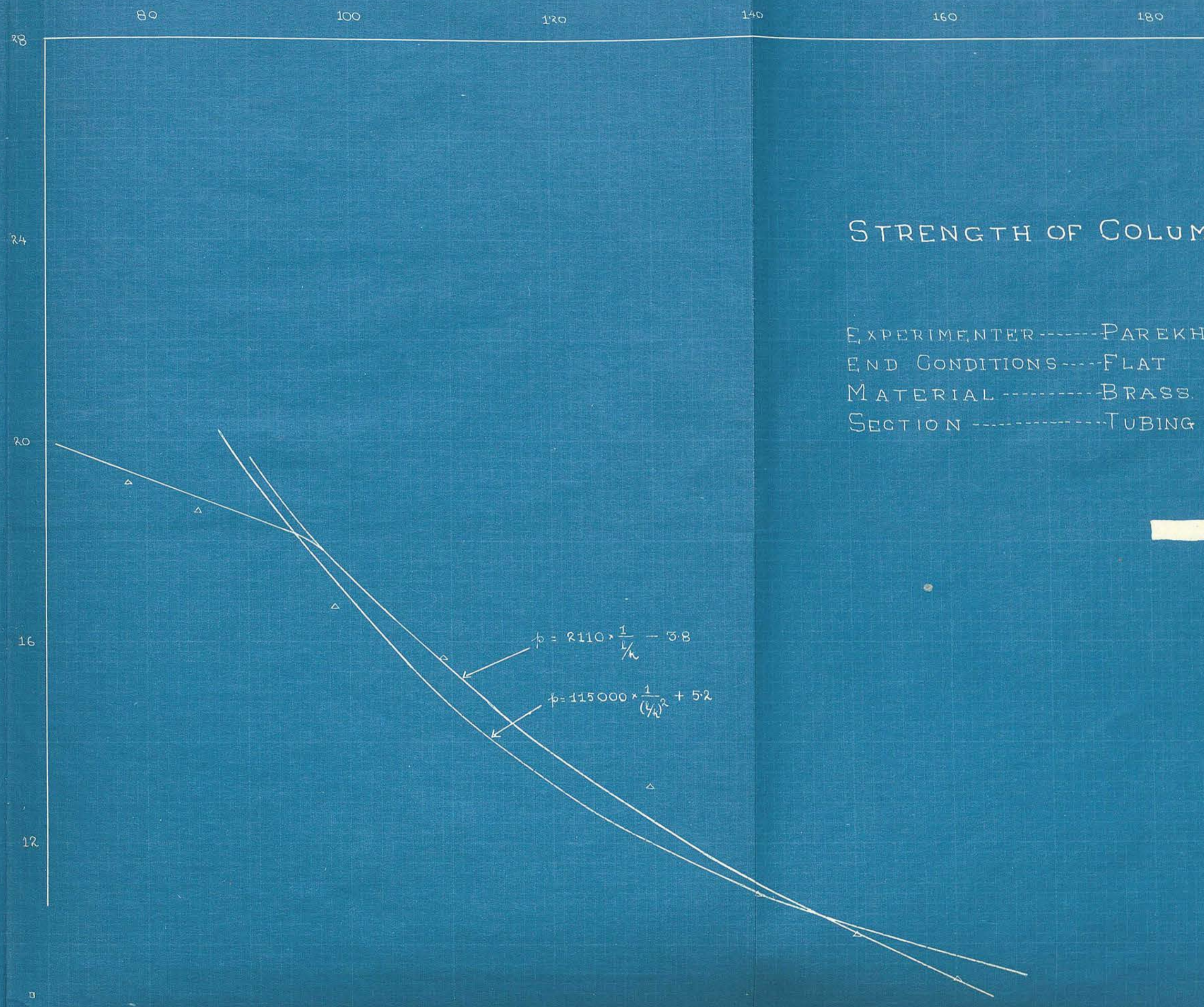
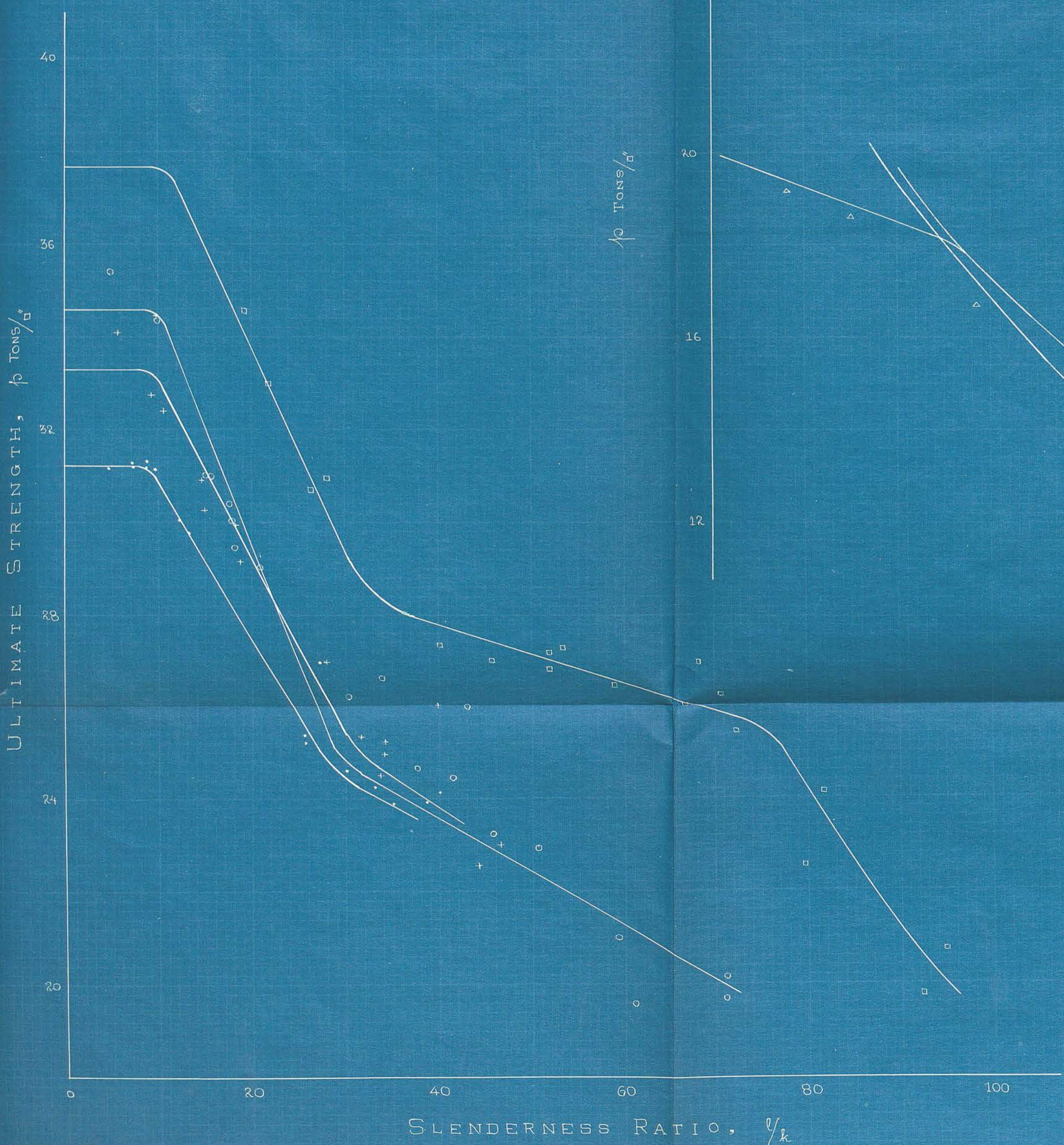


STRENGTH OF COLUMNS.

EXPERIMENTER-----PAREKH
 TUBULAR BRASS COLUMNS
 BALL AND PLATE ENDS-----SET I II III IV
 . + O □
 FLAT ENDS-----△
 GARD-BOARD ENDS-----X



l/k



STRENGTH OF COLUMNS.

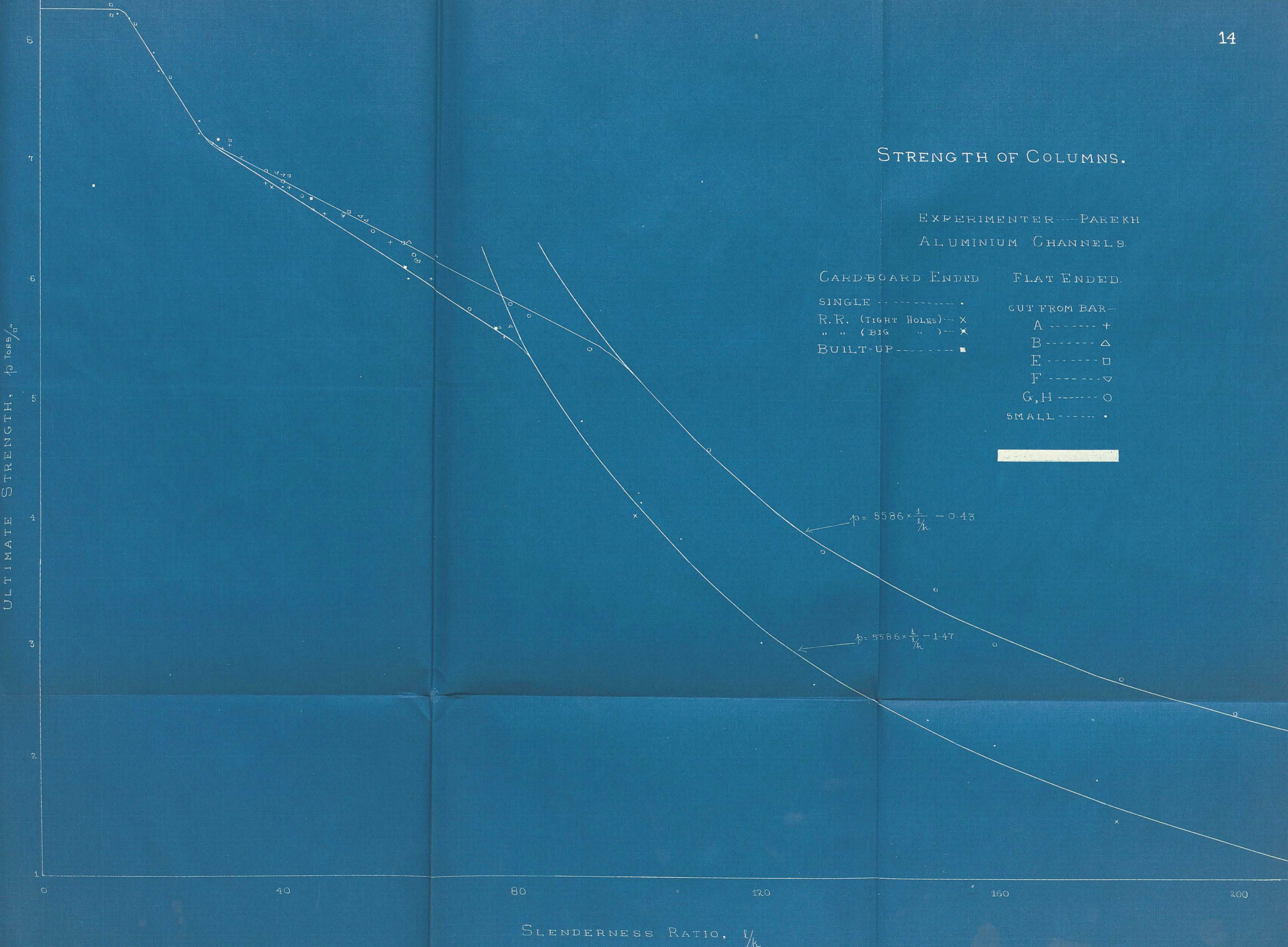
EXPERIMENTER ----- PAREKH
 END CONDITIONS ----- FLAT
 MATERIAL ----- BRASS.
 SECTION ----- TUBING I II III IV (RECUT)
 (FRESH)



STRENGTH OF COLUMNS.

EXPERIMENTER---PAREKH
ALUMINIUM CHANNELS.

- | | |
|-------------------------|---------------|
| CARDBOARD ENDED | FLAT ENDED. |
| SINGLE ----- . | CUT FROM BAR- |
| R.R. (TIGHT HOLES)--- X | A ----- + |
| " " (BIG " ")--- X | B ----- Δ |
| BUILT-UP----- ■ | E ----- □ |
| | F ----- ▽ |
| | G,H ----- ○ |
| | SMALL ----- . |



$$p = 5586 \times \frac{1}{l/k} - 0.43$$

$$p = 5586 \times \frac{1}{l/k} - 1.47$$

ULTIMATE STRENGTH, p TONS/ in^2

SLENDERNES RATIO, l/k

STRENGTH OF COLUMNS.

EXPERIMENTER ----- PAREKH

ALUMINIUM ANGLES

CARD-BOARD ENDED

FLAT ENDED

SINGLE ----- •

CUT FROM BAR -----

R.R (TIGHT HOLES) --- X

A ----- +

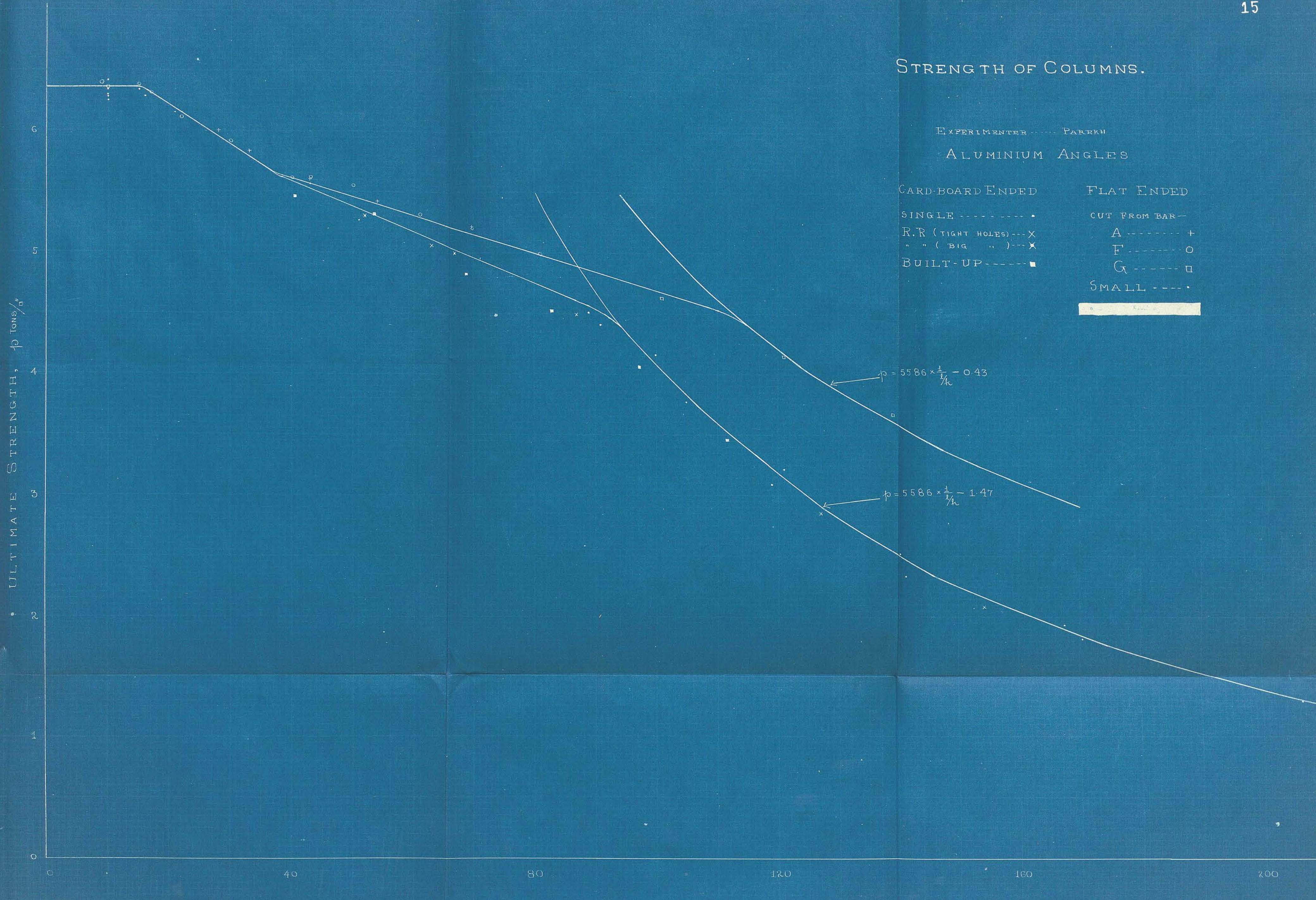
" " (BIG ") --- X

F ----- O

BUILT-UP ----- ■

G ----- □

SMALL ----- •



SLENDERNESS RATIO, l/k