Yant, Bodwell, Trees

Tests of Reinforced Concrete T-Beams

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TESTS

OF

REINFORCED CONCRETE T-BEAMS

BY

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This is to certify that the following thesis prepared under the direction of Professor A. N. Talbot, Head of the Department of Municipal and Sanitary Engineering, by

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entitled TESTS OF REINFORCED CONCRETE T-BEAMS

is accepted by me as fulfilling this part of the requirements for the Degree of Bachelor of Science in Civil Engineering.

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TESTS OF REINFORCED CONCRETE T-BEAMS

General Table of Contents.

I. INTRODUCTION.

a. Preliminary.- The object of this series of tests on reinforced concrete T-beams was to determine the effect on the strength of the beam of different web reinforcements as to the amount, quality and form, and to determine the position of the neutral axis.

b. Scope of Tests.- Sixteen beams were tested in all. The beams were all of uniform size and mixture of concrete; the flanges were 32 in. wide and 3 1/8 in. thick, the webs were 8 in. wide and 8 1/2 in. in depth, and the length was 11 ft. The longitudinal reinforcement consisted of six 3/4-in. corrugated steel bars laid horizontally except in two beams; in one of these the ends were all bent up while in the other, the two lower inside rods were left horizontal. The webs were reinforced with U-shaped stirrups; in some of the beams the stirrups being spaced 3 in. apart and in others 6 in. In some of the beams the stirrups were corrugated bars and in others plain round rods. Both mild and high carbon steels were used in sizes varying from 1/4 in. to 5/8 in. No stirrups were used in Beams No. 23, 24, 25, and 26.

II. MATERIALS, TEST PIECES, AND METHOD OF TESTING.

a. Materials.- The material used in making this concrete was the same as is ordinarily used in this section of the country. The stone was a good quality of rather hard limestone from Kankakee, Illinois, order screened through a 1-in. screen and over a 1/4-in. screen. It contained 45% to 50% voids and weighed 85 pounds per cubic foot. In the determination of the voids of both stone and sand, the material was poured slowly into water so that the voids became filled with water and no air was caught.

The sand was of good quality from near the Wabash River at Attica, Indiana. It was fairly clean, sharp and well graded, contained 28% to 30% voids, and weighed 115 pounds per cubic foot. Table I gives the results of a mechanical analysis of this sand. Results given are average of two trials.

Table I.

Mechanical Analysis of Sand.

Sieve No.	Per cent passing
5	99.7
10	80.4
12	72.5
16	65.4
18	50.5
30	26.1
40	15.6
50	6.5
74	2.7

The cement used was Universal Portland cement furnished by the Illinois Steel Co., and was of good quality. See Table II for tests.

Table II.

Fineness Test of Universal Portland Cement.

Sieve No.	1st Trial Per cent Passing	1st Trial Per cent Caught	2d Trial Per cent Passing	2d Trial Per cent Caught
50	100.00	0.00	100.00	0.00
74	100.00	0.00	99.90	0.10
100	97.00	3.00	97.00	2.90
200	81.75	15.25	78.75	18.25
Pan		81.75		78.75

Tensile Strength of Universal Cement.

Ref. No.	Ultimate Strength lb. per sq. in. Age 7 days neat	Age 7 days 1-3	Age 28 days 1-3
1	410	187	370
2	470	200	330
3	360	120	360
4	405	145	290
5	320	195	295
6	310	180	310

The concrete was made of the proportions of 1 of cement, 2 of sand, and 4 of stone, measured by loose volume. The mixing was done by hand. The sand and cement were first mixed dry and then the stone added. The stone had previously been wetted. Water was then added and the whole mass mixed until uniform in appearance. The mixing and placing was done by men experienced in concrete work. The mass was so wet that water flushed to the surface when tamped and the whole

quaked like liver under the tamping.

The steel used for the longitudinal reinforcement in all the beams consisted of six 3/4-in. high steel Johnson corrugated bars laid horizontally except in two beams. In one the rods were all bent up to within 4 in. of the top of the beam while in the other the lower two inside rods were left horizontal.

The elastic limit of the steel ranged from 53000 lb. to 63000 lb. per sq. in. The position and spacing of the bars is shown on page 10. The stirrups used were 1/4-in. and 1/2-in. mild steel corrugated bars; 1/4-in. and 1/2-in. high steel corrugated bars; and 1/2-in., and 5/8-in. mild steel round rods. Their distribution in the beams and the spacing is shown on page 10.

Table III.

TENSION TEST OF STEEL.

Longitudinal Steel.
corrugated

Beam No.	Size inches	Elastic Limit pounds	Ultimate Strength pounds	Per cent Elongation in 8 inches.	Elastic Limit lb. per sq. in.	Ultimate Strength lb. per sq. in.
11	3/4	32700	50960	10.5	58100	90500
		31800	53780	12.5	56500	95800
		35000	57930	7.5	62200	103000
		30000	49140	11.0	53400	87500
		29000	48470	18.5	51600	92000
		32000	53690	8.0	56900	95500
17	3/4	36000	55400	6.5	64000	98500
		32000	56250	11.5	57000	100000
		34500	52900	6.0	61400	94000
		34500	55150	8.0	61400	98300
		35500	52180	9.0	63100	93000
		40000	54940	7.0	71200	97800
22	3/4	36000	64690	7.0	64100	115000
		33000	54880	4.0	58700	97600
		29000	48470	5.5	51600	86200
		34000	53600	6.5	60500	95500
		26500	42700	14.0	47200	76000
		33000	54910	15.0	58700	97800
				Stirrups corrugated		
17	1/4	5340	6500	10.0	85400	104000
18	1/4	5340	6530	10.0	84200	104500
20	1/4	2480	3640	18.0	39700	58300
19	1/4	2500	3600	15.5	40000	57600

Diagram
For Obtaining
Deformations

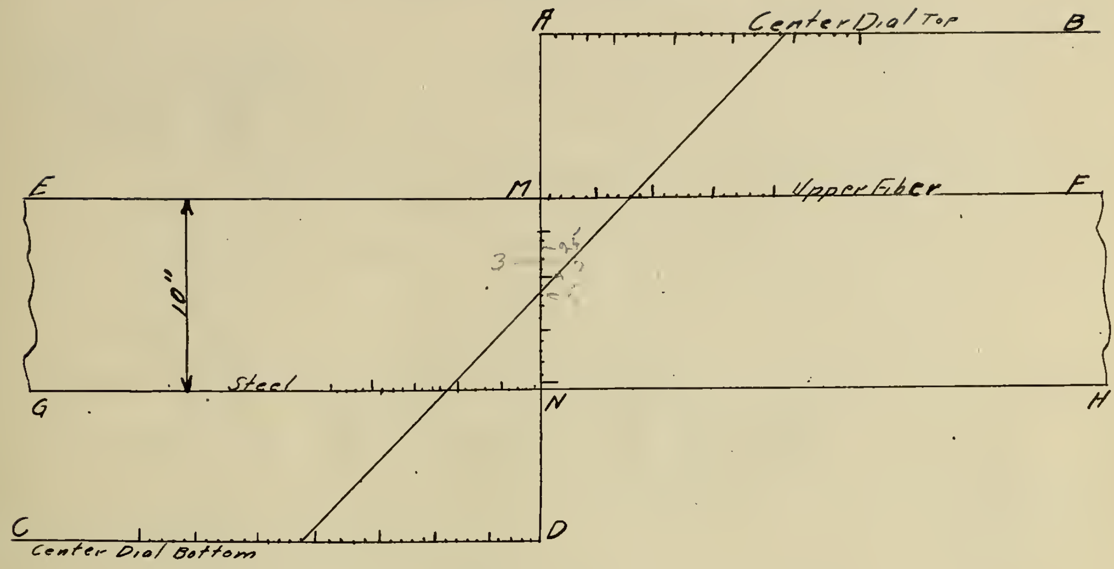


Fig. No.1

Theory.- The deformations in the upper fibers and the steel were computed on the assumption that a plane section before bending remains a plane section after bending. The deformation in any fiber is directly proportional to its distance from the neutral axis.

The average of the two upper extensometer readings was laid off to scale along the line AB on diagram and the average of the two lower extensometers was laid off along the line CD. The distance between these two lines represented to a convenient scale the distance between the centers of the upper and lower dials. To the same scale, AM represents the distance from the top of the beam (upper fiber) to the center of the upper dials, and ND the distance from the steel to the center of the lower dials. EF and GH are graduated like AB and CD. A string was stretched across from AB to CD between points which represented corresponding

readings of the dials for a certain loading, and where the string crossed the lines EF and GH values were obtained for the shortening of the upper fiber and the elongation of the steel. As the gauge length of the extensometers was 30 in. these values all have to be divided by 30 to get the unit deformation. The position of the neutral axis was obtained by noting where the string crossed the line AD, this being graduated so that each division represented a per cent of the depth from the top of the beam.

b. Test Specimens.— Table IV. shows the specimens which were made and tested. The sixteen T-beams were each 11 ft. long and the distance between supports 10 ft., the thickness of the flange was 3 1/8 in., width of flange 32 in., width of web 8 in., depth over all 12 in., and depth from top fiber to center of steel 10 in.

The proportion of longitudinal reinforcement was 1.05%, based on the area of the inclosing rectangle, as shown in Fig. 2. It was obtained by dividing the area of the steel by the product obtained by multiplying the width of flange by the effective depth. The reinforcing rods were symetrically arranged with respect to the axis of the beam. In one of the beams, a part of the rods were turned up beyond the one-third points to within 4 in. of the top of the beam, and in another all the rods were turned up beyond the one-third points. For spacing and size of stirrups see Fig. 2. The stirrups passed under the longitudinal steel, alternate

ones inclosing only the middle two bars.

Table IV.

List of Test Specimens

All beams have longitudinal reinforcement of 6, 3/4-in. Johnson bars 10 ft. 6 in. long placed as shown in Fig.2.

T-beams

No.	Stirrups Kind	Spacing in inches
11, 12	1/2-in. high steel corrugated bars	6
13, 14	1/2-in. mild steel corrugated bars	6
15, 16	5/8-in. mild steel round rods	6
17, 18	1/4-in. high steel corrugated bars	3
19, 20	1/4-in. mild steel corrugated bars	3
21, 22	1/2-in. mild steel round rods	3
23, 24	No stirrups, bars horizontal.	
25, 26	No stirrups, bars bent up.	

Method of Reinforcing

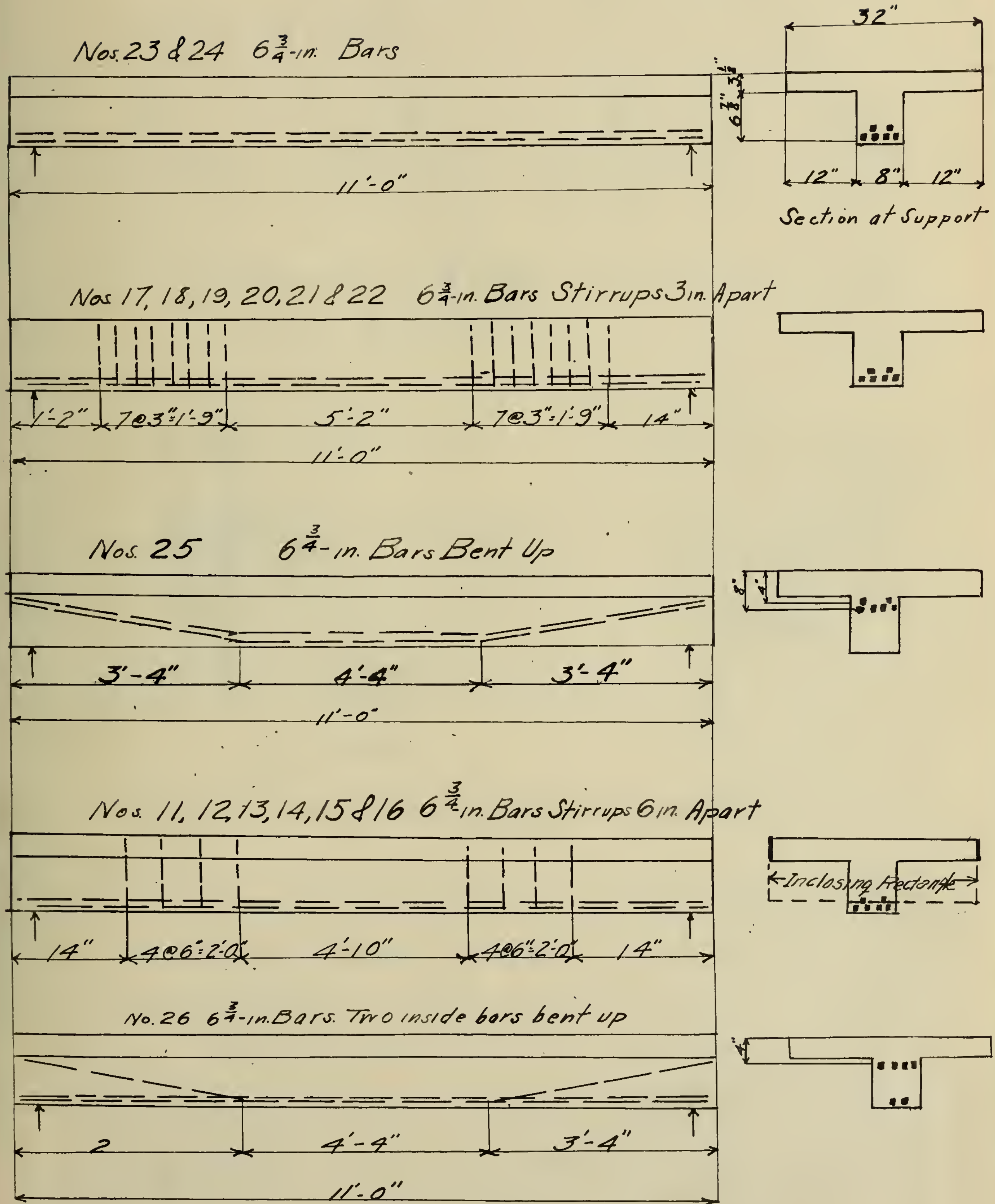


Fig. No 2.

Forms

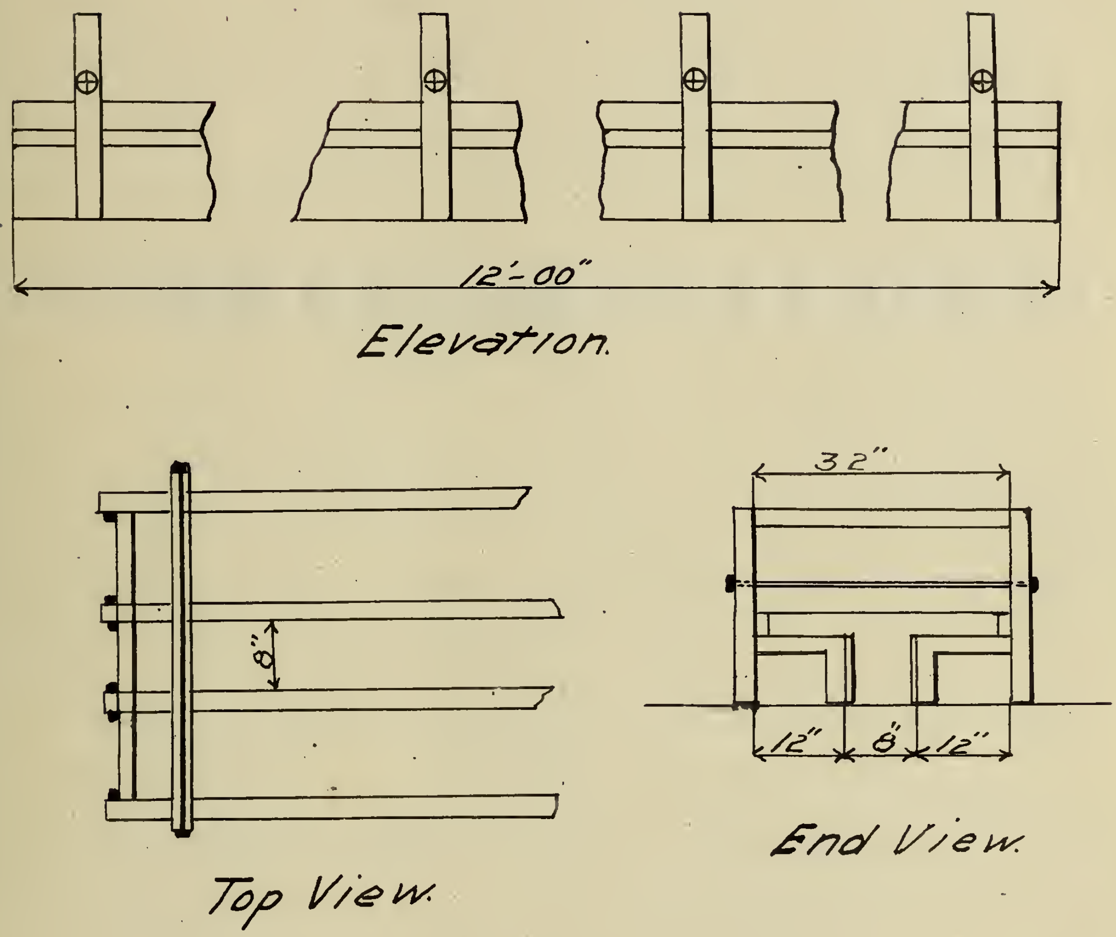


Fig. No. 3.

c. Forms.- The above figure shows the make-up of forms used in making the beams. Two-inch planks were used for all parts of the forms. Clamps and struts were of 2-in. x 4-in. pieces. The planks were soaked in water for some time before using in order to prevent the absorption of water from the concrete. All parts were reversible and by alternating the side which was placed next to the concrete, warping was prevented.

d. Fabrication and Storage.- The beams were made on the concrete floor of the laboratory, strips of building paper being laid on the floor to prevent the concrete from adhering to it. The concrete was proportioned by loose volume and mixed by hand, generally one batch being mixed for each beam.

Concrete was put in the form and leveled off to a depth of about an inch and a half and the longitudinal rods placed so that the distance from the top of the finished beam to the centroid of these rods would be 10 in. The beam was completed by putting in layers of concrete about three inches thick and tamping, and spading the sides.

The beams were sprinkled twice a day until tested. The temperature of the room ranged from 60° to 70° F. The forms were taken off after ten days. The beams were tested when 60 days old.

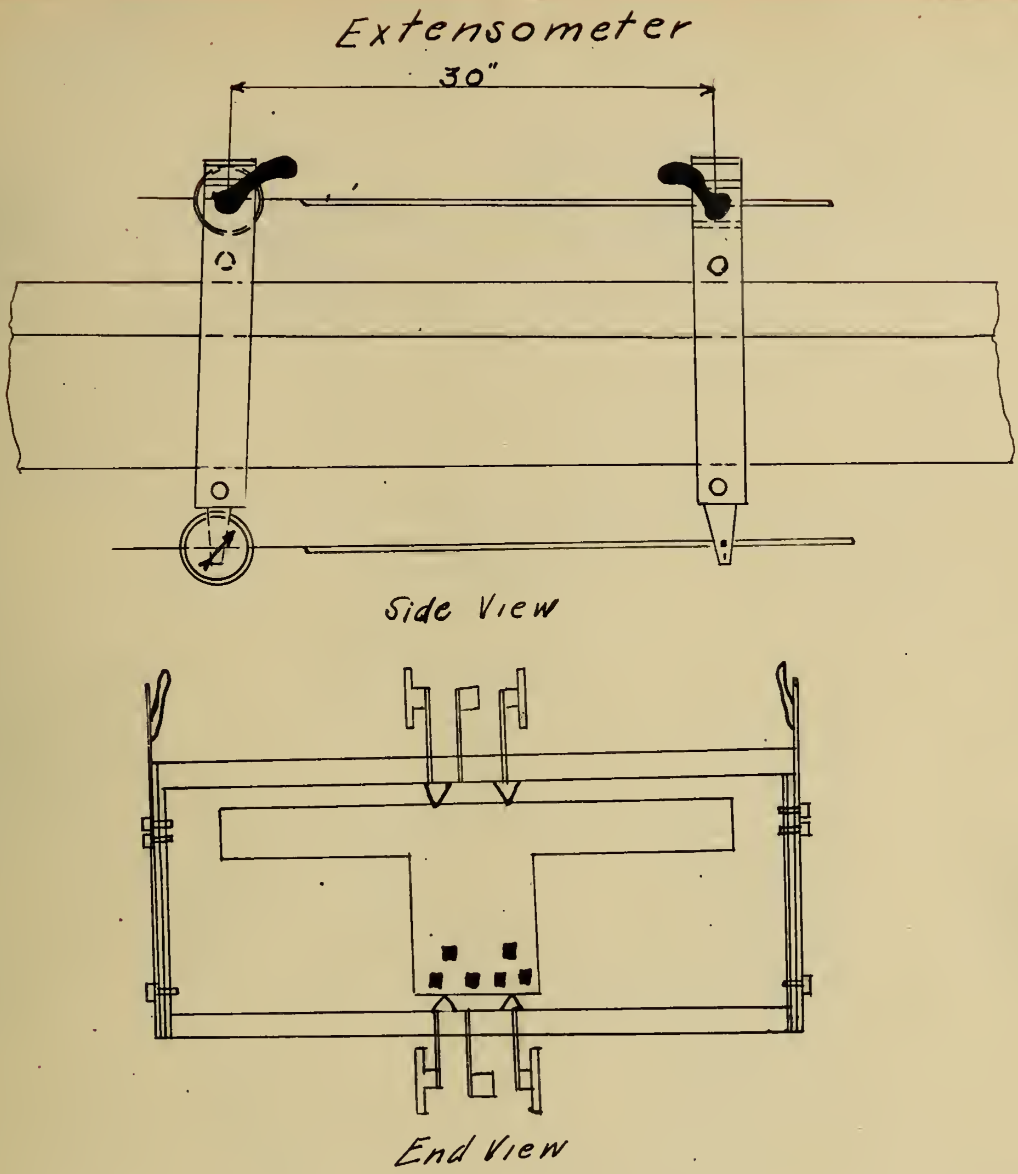


Fig. 4.

e. Description of Apparatus.

The extensometer device is shown in Fig. 4, and was designed and built in the workshop of the Laboratory of Applied Mechanics of the University of Illinois. It consists of two yokes, on one of which are four dials. The yokes were placed 30 in. apart and symmetrically with respect to the middle of the beam. The rollers were 22 1/8 in. apart vertically and the upper ones were 5 1/4 in. above the top of the beam. The rollers were 0.5 in. in circumference, the dials 4 in. in

diameter, and the graduations such that readings were obtained to 0.0001 in. The second yoke was provided with fixed pins placed in positions corresponding to the rollers.

Method of Testing

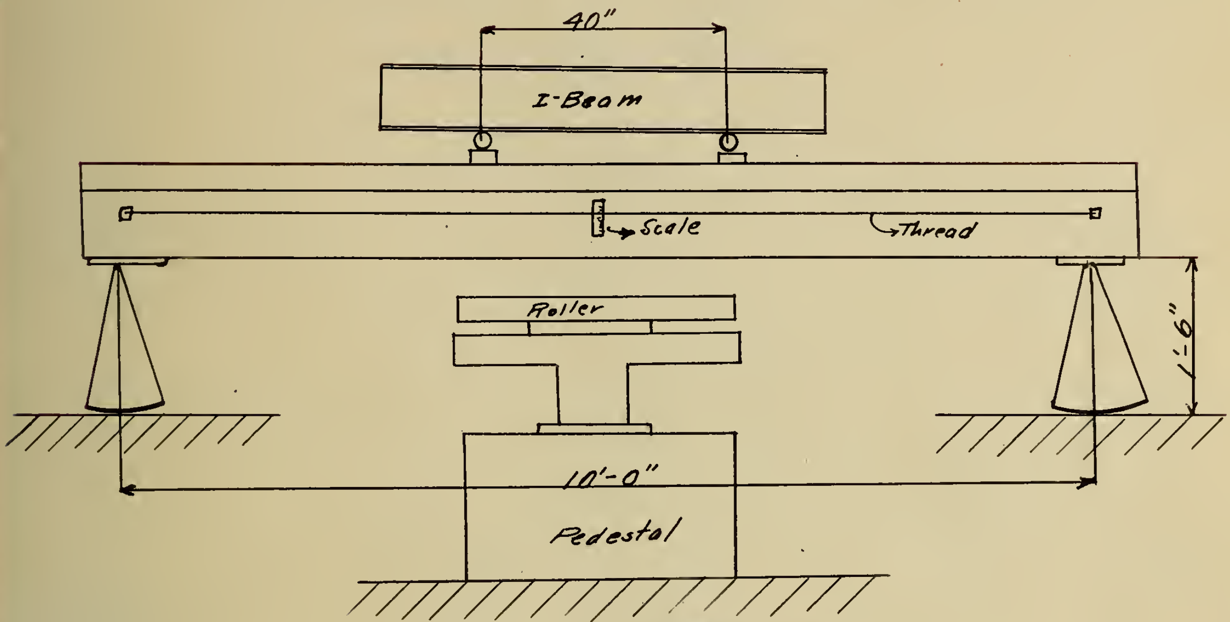


Fig. No 4.

f. Method of Testing.– The beams were loaded as shown in Fig. 4, the points of application of the load being the 1/3 points of the beam. The machine used was the Riehlé 600 000–lb. testing machine. The beams rested upon pedestals 10 ft. apart; the surface of the bases were curved to permit rocking. Between the pedestals and beam, bearing plates, 8 in. x 12 in. x 1 in. were used. Two cast iron plates, 2 in. x 3 in. extended across the top of the beam at the 1/3 points.

On T–beams No. 25, 23, 13, and 11, the 2–in. x 3–in. plates extended the entire width of flange, but on Beams No. 15, 19, 21, 16, 18, 12, 14, 26, 24, 22, and 20 the length of the plates was only 12 in., so placed that the ends extended only two inches beyond the lines of the sides of the web on each side. Upon these plates, which were faced, rested

4-1/2-in. turned steel rollers. The load was distributed to these rollers by the I-beam as shown.

The movement of the head, in testing, was 1/20 in. per minute. Center deflections were read by means of a scale attached on the center of the side of the web as indicated. A thread extended across from two points above the supports about 7 in. from the top of the beam and the different positions of the thread over the scale gave the deflection readings. The deformations in the upper and lower fibers were obtained by calculations made from readings taken with the Johnson extensometer device described in paragraph e. The loads were increased in increments of 3000 to 5000 lb., and between increments the machine was stopped to take readings.

To secure an even and uniform bearing, plaster of paris was put between the plates and beam, which was permitted to harden before the load was applied.

Steel rods 3/8-in. in diameter with V-shaped notches near one end that fitted over the fixed pins, were laid across to the rollers. On the other end of the rods were steel strips with rounding surfaces that rested directly upon the rollers and caused them to turn as the beam deformed under the load.

On some of the beams there was another device for measuring the deformations. It consisted of dials attached to each of the yokes mentioned above, between the Johnson dials. A wire was stretched from each dial to a corresponding position

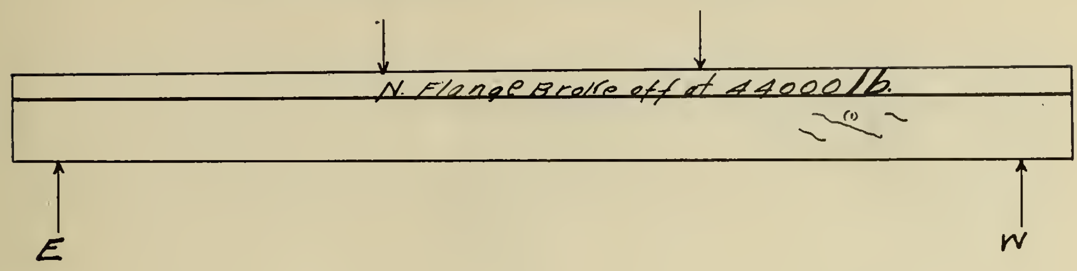
on the other yoke. The upper dial was 6-3/4 in. above the top of the beam and the lower 6-1/4 in. below the bottom. The dials were so graduated that they read to .001 in. The dials were calibrated before the beginning of this series of tests. The readings were not very satisfactory when the first few loads were applied. These varied readings were thought to be due to the back lash in the wire and instrument.

III. EXPERIMENTAL DATA AND DISCUSSION.

a. Deflection and Deformation Diagrams.- The curves at the back part of the book represent the deflections of the beams at the center, the deformations of the upper fibers and the steel, and the position of the neutral axis. The curves in black ink were plotted from computations made from the readings taken from the Johnson extensometer and those in red from the dials. The ordinates represent the applied loads and the abscissas the corresponding deflections at the center of the beam, and also corresponding unit deformations in the upper fiber and steel.

For the neutral axes, the loads are plotted as abscissas; and for ordinates, the per cent of the total depth of beam that the neutral axis is below the top of the beam.

T-Beam No. 11 After Failure

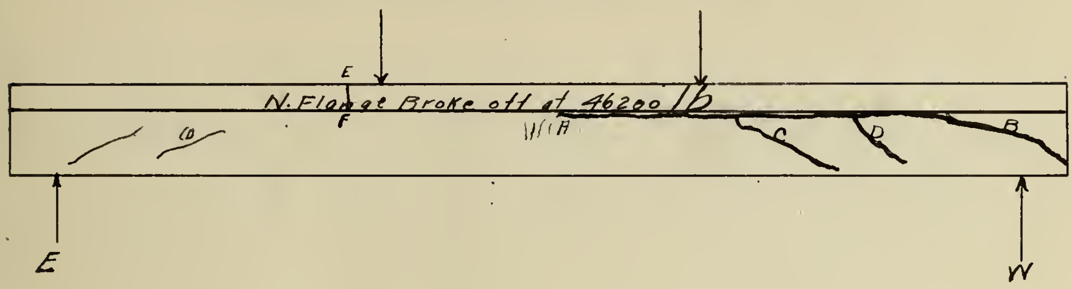


b. Phenomena of Tests.- Beam No. 11.

This beam was reinforced with stirrups of 1/2-in. high steel corrugated bars spaced 6 in. apart.

At 40 000 lb. the first crack appeared on the web about midway between the west support and the nearer third point. This hair-like crack was about two inches long, extending in a diagonal direction sloping toward the support. When the load was again applied, the crack slightly increased in length,at about 42 000 lb. two other similar cracks appeared near the first one, and just as 44 000 lb. was reached, without warning the north flange for the entire length of the beam broke off even with the side of the web. The total observed deflection at 40 000 lb. was 0.26 in. Upon examining the break it was noticed that quite a number of the stones were broken in two. Most of these broken stones were along the upper line of the break. The fracture was clean cut, well defined and nearly vertical.

T-Beam No. 12 After Failure



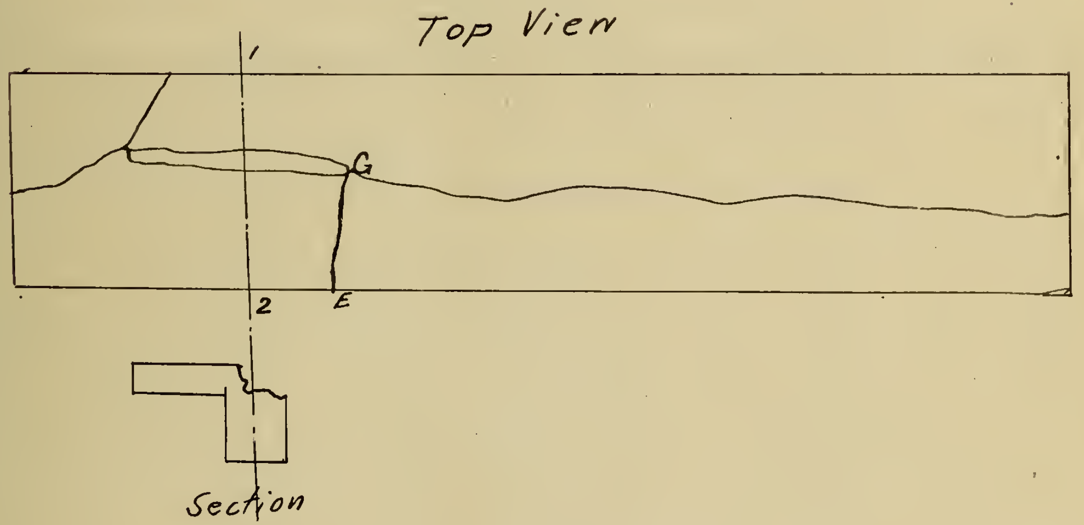
Beam No. 12 was like No. 11 in that it was reinforced with stirrups of 1/2-in. high steel corrugated bars spaced 6 in. apart. The first crack appeared at 28 000 lb. The diagonal cracks in the web were only small ones. The two principal ones, C and D, extended up to the junction of flange and web and then ran along this joint as shown by A B. This crack grew larger and near the center of the beam just under the flange some of the concrete scaled off. At 41 000 lb. a longitudinal crack appeared on the top of the flange, and at 44 000 lb. extended the whole length of the top surface, as shown by top view and crack EF–EG appeared at 46 200 lb., the entire flange was nearly broken off and with a slight blow it fell. This flange broke off in a somewhat different manner from that in No. 11, in that it did not follow the junction of the web and flange but broke off very irregularly.

Owing to the breaking off of flange on Beam No. 11 we thought perhaps it was due to the load being applied over the entire width of the flange. On Beam No. 12 shorter bearing plates were used. These plates were 12 in. long and extended over the flange only two inches beyond the sides of the web, thus preventing undue pressure on the outer portion

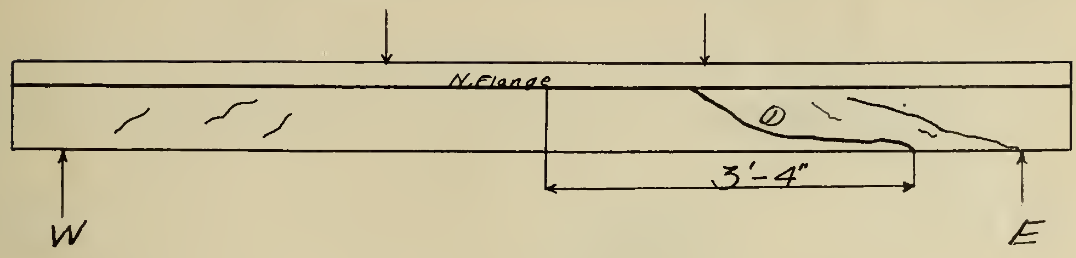
of the flange due to any uneveness of top surface of the beam.

It seems that the irregular jagged fracture of Beam No. 12 was caused by using shorter bearing plates than in Beam No. 11, thus relieving the outer portion of the flange from direct load.

The beam broke at 46 200 lb. with a center deflection of 0.44 in.



T-Beam No. 13 After Failure



Beam No. 13 was reinforced with stirrups of 1/2-in. mild steel corrugated bars spaced 1/2. in. apart.

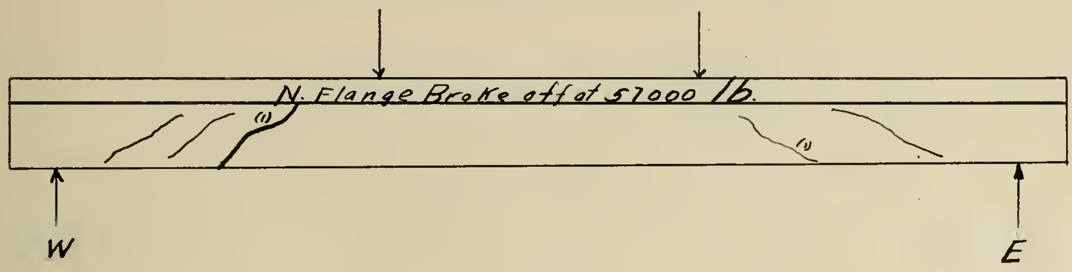
This beam when being put into the machine fell, striking about 8 in. from the middle, causing a crack across the flange and extending from the upper surface of flange to within an inch and a half of the bottom of the web. This did not appear to cause any weakness in the beam.

At 45 100 lb. a hair-crack about 4 in. in length appeared at the east end of the beam on the south side about 1 ft. west of east support. The next crack was on the west end about 1 ft. 6 in. from west support on the north side at 48 000 lb. At 51 100 lb. the first crack grew a little larger, and two new cracks appeared at west end on south side as shown in sketch. Also new cracks at east end on both sides in vicinity of first crack. The cracks on the west end did not develop farther, but those on the east end grew larger and larger. Between 54 000 and 57 000 lb. slight cracking noises were heard at east end and at 58 000 lb. there was a sharp report and beam broke where first crack appeared, by diagonal tension.

When the beam was broken up it was found that a stirrup was broken where the first crack appeared.

The maximum deflection at the center was 0.58 in.

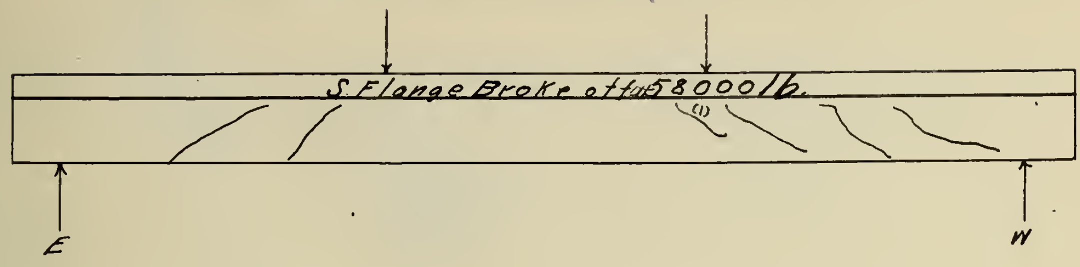
T-Beam No. 14 After Failure



Beam No. 14 was reinforced the same as No. 13, 1/2-in. mild steel corrugated bars spaced 6 in. apart being used for stirrups. The failure of this beam was similar to that of No.11. The north flange broke off flush with web. Instead of being a vertical fracture it was inclined about 45° as shown in sketch. The 12 in. bearing plates were used on this beam.

Two cracks appeared at 39 000 lb., one on each side of the web about 2 ft. inside of the west support. Other cracks appeared at 46 000 and 54 000 lb. The 39 000 lb. crack on the west end joined with the 54 000 lb. crack which then extended the full depth of the web. The north flange broke off suddenly at 57 000 lb. The maximum center deflection was 0.42 in.

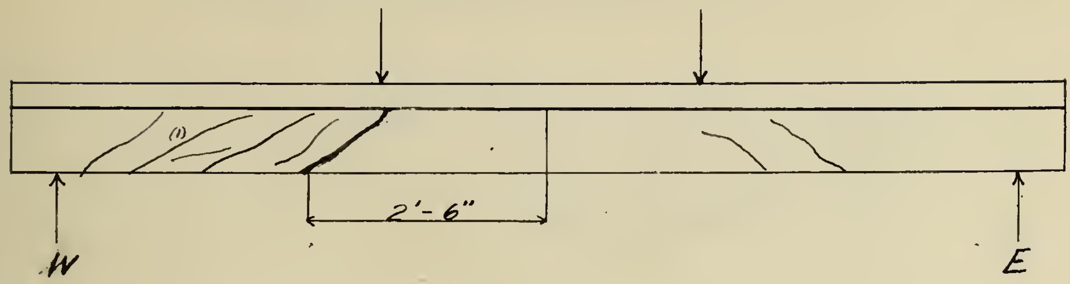
T-Beam No. 15 After Failure



The stirrups in Beam No. 15 were 5/8-in. mild steel round rods spaced 6 in. apart.

At 35 000 lb. a minute crack appeared at west end 1 ft. east of support, and at 40 000 lb. cracks appeared at both ends midway between supports and middle thirds; at 50 000 lb. and 55 000 lb. more cracks appeared in vicinity of first crack. At 58 000 lb., without warning the entire south flange broke off close to the web. In examining the break it was noticed that many of the stones were broken in upper half of break. The instruments were removed and the loading continued. When the load reached 47 000 lb. the other flange broke off. The diagonal cracks in the web were small and did not seem to have any effect on the failure of the beam, although the failure was much the same as Beam No. 11 where the long plates were used.

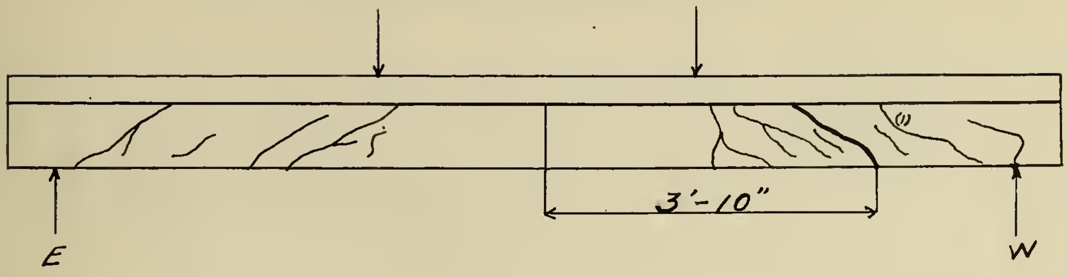
T- Beam No. 16 After Failure



The stirrups in Beam No. 16 were the same as in Beam No. 15, 5/8-in. mild steel round rods, spaced 6 in. apart.

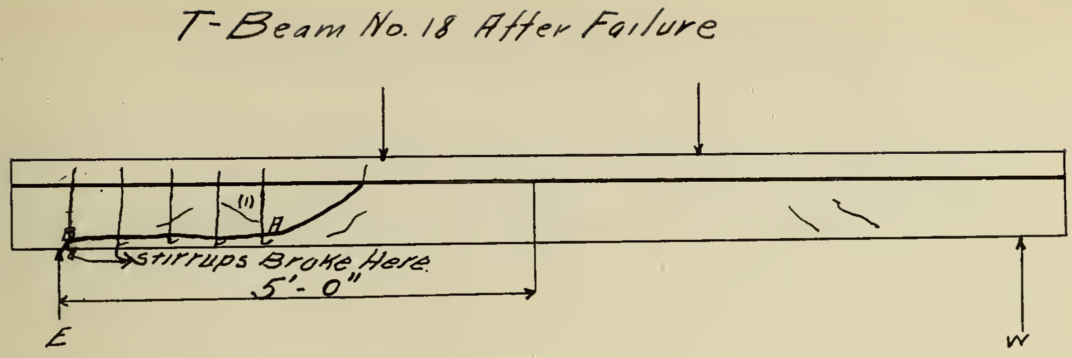
The first minute crack appeared at west end 1 ft. 6 in. from east support at 32 000 lb. Three other small cracks appeared at 40 000 lb. about 1 ft. 9 in. from support. As the load increased the cracks above mentioned increased in length and many new ones appeared about 2 ft. 3 in. from support. The cracks increased in length, and at 57 600 lb. the beam would not support any more load, and failed by diagonal tension in the concrete about 3 ft. from west end. Maximum center deflection 0.52 in.

T-Beam No. 17 After Failure



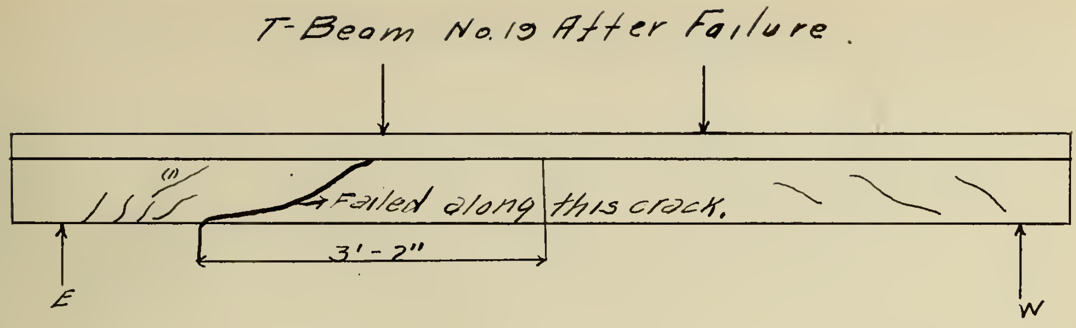
The stirrups in Beam No. 17 were 1/4-in. high steel corrugated bars spaced 3 in. apart.

Numerous cracks appeared at the west end about 2 ft. from west support, the first one being visible at 39 000 lb. 1 ft. 6 in. from west support. At 42 000 lb. a diagonal crack appeared in the middle of the web about 26 in. from the west support. At 48 000 lb. this crack extended up to the flanges, and at 66 000 lb. it reached the bottom of the web. The beam failed along this crack by diagonal tension at 69 000 lb. There were many small cracks near this one, also several in the east end as shown in sketch. Maximum deflection was 0.41 in.



The stirrups in Beam No 18 were the same as in No. 17, 1/4-in. high steel corrugated bars spaced 3 in. apart.

Only two short hair cracks appeared on the west end about 1 ft. 8 in. from support. On the east end the first crack appeared at 32 000 lb. It was a hair crack about 4 in. long sloping away from support, about 20 in. from support. At 40 000 lb. a crack appeared as shown in sketch, which elongated and widened as the load was increased until at 52 000 lb. the beam failed along this crack, with a muffled sharp report. The concrete fell off along the line AB disclosing the reinforcement and stirrups. The two stirrups indicated in sketch were broken at the bend. The longitudinal rods slipped in the vicinity of the failure. The crack extended into the flange to within 3/4 in. of top of beam. The maximum center deflection was 0.37 in.

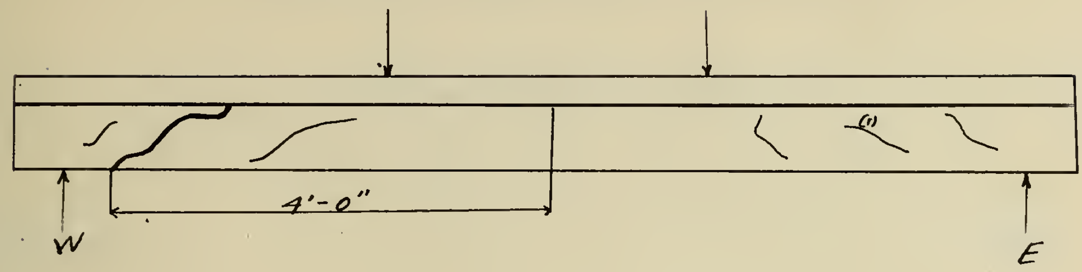


The stirrups in Beam No. 19 were 1/4-in. mild steel corrugated bars spaced 3 in. apart.

The first crack appeared at east end 1 ft. 3 in. west of support at 35 000 lb. New cracks appeared at both ends at 40 000, 50 000, and 55 000 lb. all being about 2 ft. from supports. The 35 000 lb. crack did not increase with increase of load. The 45 000, 50 000, and 55 000 lb. cracks grew into each other as the load increased after 55 000 lb. until the load reached 60 000 lb. and then the beam failed along these combined cracks as shown in sketch. There was a muffled report at failure. The center deflection was .39 in.

Where failure occured the concrete did not seem to be of as good quality as the other beams tested. There was a large amount of stone with very little sand and cement in the voids.

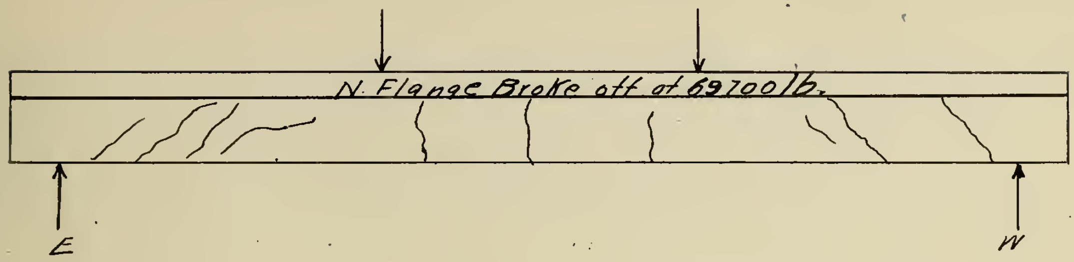
T-Beam No 20 After Failure



The stirrups in Beam No. 20 were the same as in No. 19, composed of 1/4-in. mild steel corrugated bars spaced 3 in. apart.

This beam broke in a manner similar to No. 19. The first crack appeared at 30 000 lb. at west end on both sides of beam 1 ft. 6 in. east of west support. It failed at 57 400 lb. and the cracks were not very large. The maximum center deflection was 0.39 in.

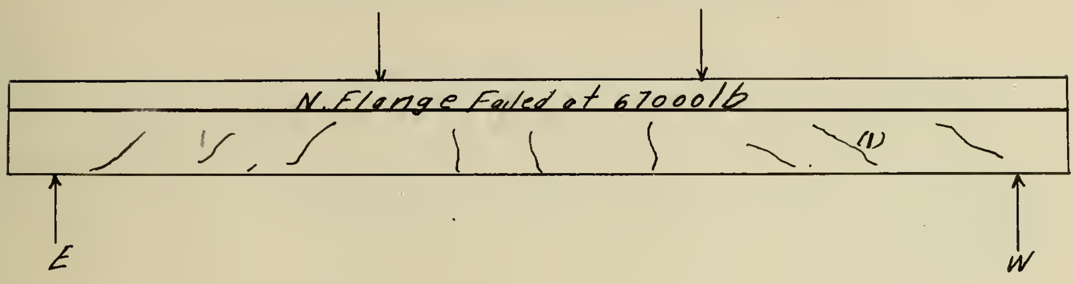
T-Beam No. 21 After Failure



The stirrups in Beam No. 21 were 1/2-in. mild steel round rods spaced 3 in. apart.

Diagonal cracks appeared in this as in the other beams and in addition three small vertical cracks appeared in the web within the middle third. (Their position is shown in the sketch.) These cracks did not appear until the load reached 52 000 lb. The first hair-like crack appeared in the west end at 36 000 lb. 2 ft. 6 in. east of west support. At 69 700 lb. the beam failed by the breaking off of the north flange. The maximum deflection was 0.43 in.

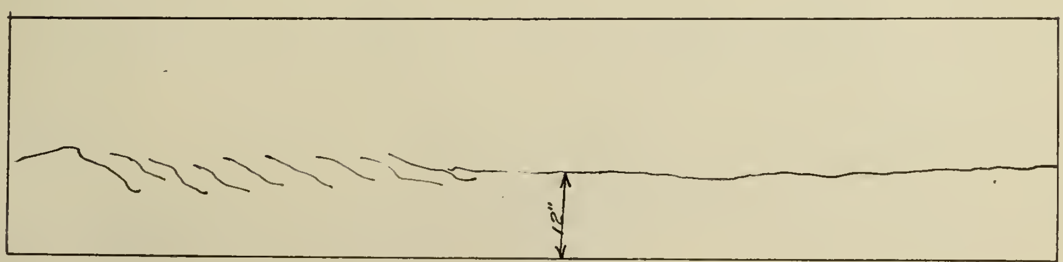
T-Beam No. 22 After Failure



The stirrups in Beam No. 22 were the same as in No. 21, 1/2-in. mild steel round rods spaced 3 in. apart.

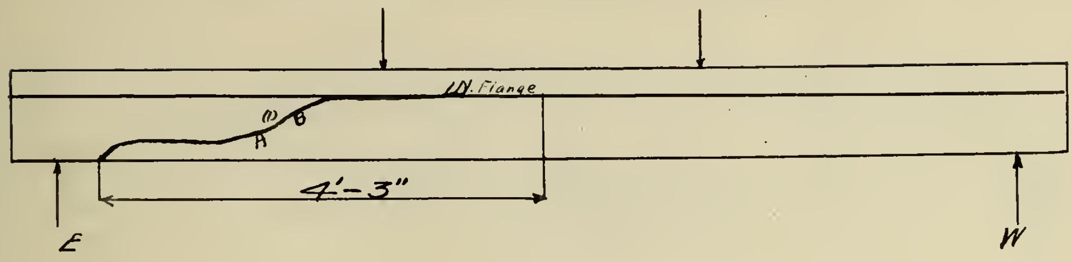
The first cracks appeared at 35 000 lb. in the web of the outside thirds 2 ft. from supports. At 60 000 lb vertical cracks appeared in the center midway between the 1/3 points.

This beam and Beam No. 21 were the only ones that had cracks between the load points. The flange failed at 67 000 lb. but did not drop entirely off. At the edge of the flange the amount of deflection from a horizontal plane was 3/8 in. The appearance of the crack on the top of the beam was as shown in sketch. Beneath the flange the crack extended three-fourths the length of the beam from the west end, and followed along the intersection of flange and web. Between the loads on top of flange the crack was straight and was not jagged, but on the east end the cracks were very irregular, as incidated. The center deflection was 0.47 in.



Top View

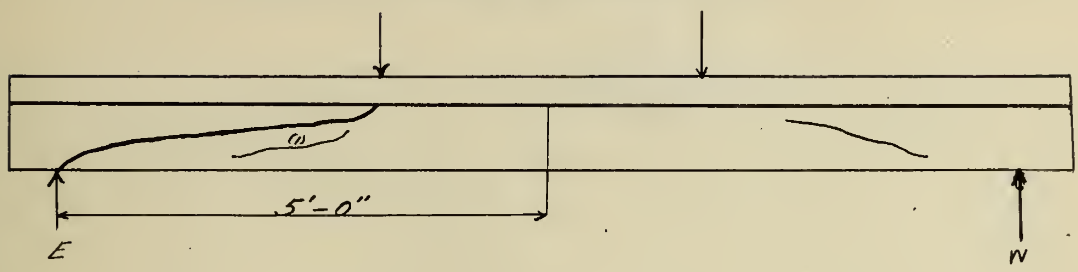
T-Beam No. 23 After Failure



Beam No 23 had no stirrups. The longitudinal bars were horizontal.

Just as the load was applied after reaching 25 200 lb. a slight crack appeared in section AB . As the load increased this crack extended rapidly in both directions and also became wider. At 29 000 lb. the crack was as shown in sketch, being 1/2 in.wide and having a total length of 33 in., horizontal projection. This load caused failure. The crack was the same on both sides of the web. From upper extremity of crack on south side of web the crack continued out on the under side of the T as shown in sketch above but did not appear upon upper side of T. The center deflection was 0.12 in.

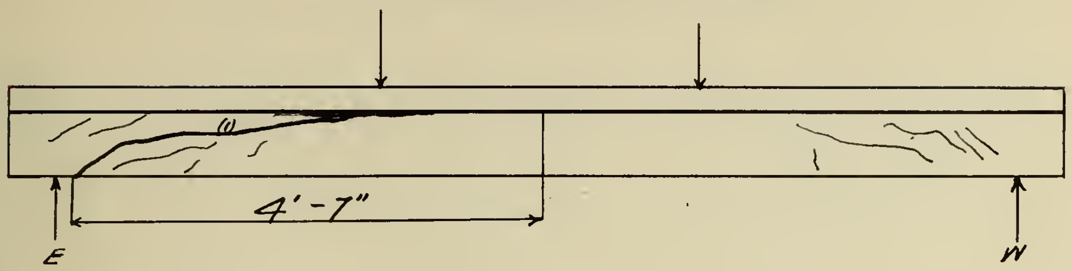
T-Beam No. 24 After Failure



Beam No. 24 had no stirrups. Bars horizontal.

The first crack appeared at 27 000 lb. about 2 ft. west of east support. The diagonal crack in web was large and appeared quite suddenly. This crack extended the full width of flange, and entire depth of web. The beam failed at 28 000 lb. by diagonal tension, and strip of bond. There were only three cracks in the beam, and they appeared about the same time. This beam broke differently from the others owing to suddenness of break and small number and size of cracks. The maximum center deflection was 0.15 in.

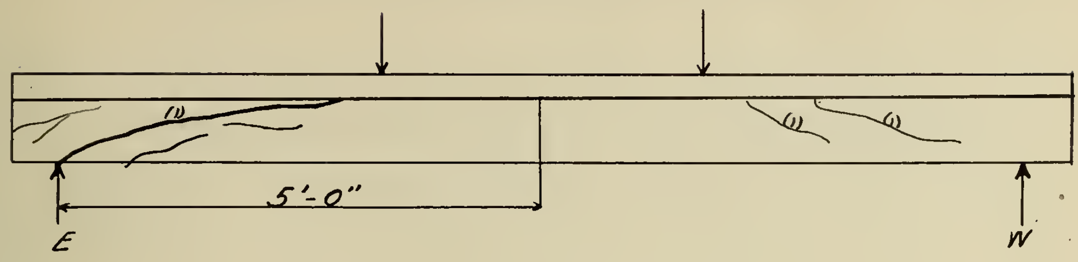
T-Beam No. 25 After Failure



Beam No. 25 had no stirrups. Bars bent up.

The first crack appeared in the center of the web about 2 ft. west of east support. As the load increased the crack extended in both directions, and new cracks appeared which joined with the first one along the intersection of the web and flange. Just west of the load point the concrete scaled off on the under side of the flange. The beam broke suddenly at 48 000 lb. with a maximum center deflection of 0.36 in.

T-Beam No. 26 After Failure



Beam No. 26 had no stirrups.. Bars bent up.

This beam was very similar to Beam No. 25. The cracks formed in a similar manner and the beam gave way under a load of 41 000 lb. with a center deflection of 0.28 in.

c. Tension in Steel.– The curves plotted gave no indication that the beams failed by tension in the steel. In Table V. are given the calculated stresses in the reinforcement at the maximum load based on the formula $M = 0.86\ Afd.$ The maximum load included the applied load and weight of the apparatus.

The elastic limit of the steel as determined by tests upon test specimens of the steel used in the various beams was from 20% to 200% greater than the stresses in the steel as computed from the maximum loads which the beams carried.

The stresses were computed by the formula $M = .86\ Afd$ in which A = area of cross section of longitudinal reinforcement, f = tensile stress per unit of area in longitudinal reinforcement, d = distance from the compressive face to the centroid of the longitudinal reinforcement, and M = resisting moment at the given section.

Table V.

RESULTS OF TESTS OF T-BEAMS

$M = 0.86\ Afd$

Beam No.	Web Reinforcement Kind	Maximum Load pounds: Applied Load	Maximum Load pounds: Beam and Apparatus	Bending Moment lb.-in.	Stress in Steel lb. per sq. in.
11	Stirrups 1/2-in. high steel corrugated bars spaced 6 in.	44000	46,500	917,500	31,670
12	Stirrups 1/2-in. high steel corrugated bars spaced 6 in.	46200	48,700	961,500	33,350
13	Stirrups 1/2-in. mild steel corrugated bars spaced 6 in.	58300	60,800	1,203,500	41,700
14	Stirrups 1/2-in. mild steel corrugated bars spaced 6 in.	57000	59,500	1,177,500	40,670
15	Stirrups 5/8-in. mild steel round rods spaced 6 in.	58000	60,500	1,197,500	41,400
16	Stirrups 5/8-in. mild steel round rods spaced 6 in.	~~76000~~ 576[illegible]	~~79,500~~ 60 100	1,189,500	41,200
17	Stirrups 1/4-in. high steel corrugated bars spaced 3 in.	69000	71,500	1,417,500	48,900
18	Stirrups 1/4-in. high steel corrugated bars spaced 3 in.	52000	54,500	1,077,500	37,300
19	Stirrups 1/4-in. mild steel corrugated bars spaced 3 in.	60000	58,100	1,237,500	42,700
20	Stirrups 1/4-in. mild steel corrugated bars spaced 3 in.	55000	57,500	1,137,500	39,400
21	Stirrups 1/2-in. mild steel round rods spaced 3 in.	69700	72,200	1,431,500	49,600
22	Stirrups 1/2-in. mild steel round rods spaced 3 in.	67000	69,500	1,377,500	47,630

Continued.

Table V.

RESULTS OF TESTS OF T-BEAMS

M = 0.86 Afd.

Beam No.	Web Reinforcement Kind	Maximum Load pounds Applied Load	Beam and Apparatus	Bending Moment lb.-in.	Stress in Steel lb. per sq. in.
23	No Stirrups. Bars horizontal.	23200	26,300	617,500	21,400
24	No stirrups. Bars horizontal.	28000	30,500	597,500	20,700
25	No stirrups. Bars bent up.	48000	48,300	497,500	34,400
26	No stirrups. Bars bent up.	40000	42,500	837,500	28,980

d. Web Stresses.- The load which the beam will carry is much increased by the web reinforcement. The stress developed in the stirrups under the maximum load varied from 4 600 lb. to 10 700 lb. The shear in the web was 83 to 144 lb. per sq. in., and under the maximum load varied from 173 to 510 lb. per sq. in. The bond developed at maximum load varied from 77 to 218 lb. per sq. in. In general, the strength of the beams depended upon the spacing of the reinforcement. In Table VI. are given the values of the vertical shearing unit stresses for the maximum load calculated by equation $v = \frac{V}{b'd'}$.

V = total shearing stress
v = vertical shearing stress per unit area.
b′ = breadth of stem of T-beam.
d′ = distance from the center of the longitudinal reinforcement to the center of gravity of the compressive stresses.
V′ = vertical shearing stress per sq. in. when first crack appeared.

Table VI.

WEB STRESSES.

Beam No.	At first Diagonal Crack Load in pounds With Apparatus	lb. per sq. in. V′	At Maximum Load Bond U lb. per sq. in.	Shear V lb. per sq. in.	Total Stress in one prong of Steel.	Manner of Failure
11	44 600	295	132	325	7080	Flange broke off.
12	28 600	208	150	339	8130	Flange broke off.
13	45 700	332	186	428	10700	Diagonal tension.
14	39 600	288	186	418	10032	Flange broke off.
15	35 600	259	179	426	9700	Flange broke off.
16	32 600	237	183	423	9880	Diagonal tension.
17	39 600	288	215	506	5830	Diagonal tension.
18	32 600	237	170	382	4600	Diagonal tension.
19	35 600	259	179	441	4870	Diagonal tension.
20	30 600	222	179	404	4870	Diagonal tension.
21	36 600	267	226	510	6150	Flange broke off.
22	35 600	259	218	492	5920	Flange broke off.
23	25 800	188	77	215	No.stir.	Diagonal tension.
24	24 600	179	92	208	do.	Diagonal tension.
25	45 800	333	145	353	do.	Diagonal tension.
26	30 600	223	131	295	do.	Diagonal tension.

Table VII.

STRESS IN STIRRUPS.

Beam No.	Kind of Stirrup	Total stress on each prong of stirrup pounds	Unit stress on each prong of stirrup. lb. per sq. in.	Bond lb. per sq. in.
11	1/2-in. high steel corrugated bars spaced 6 in. apart.	7080	28 300	708
12	do.	8130	32 500	813
13	1/2-in. mild steel corrugated bars spaced 6 in. apart.	10700	42 800	1070
14	do.	10032	40 130	1003
15	5/8-in. mild steel round rods spaced 6 in. apart.	9700	31 600	990
16	do.	9880	32 100	1000
17	1/4-in. high steel corrugated bars spaced 3 in. apart.	5830	96 500	1166
18	do.	4600	76 400	920
19	1/4-in. mild steel corrugated bars spaced 3 in. apart.	4870	81 000	974
20	do.	4870	81 000	974
21	1/2-in. mild steel round rods spaced 3 in. apart.	6150	31 400	782
22	do.	5920	30 200	755

The bond on the stirrups was computed by dividing the total stress on each prong by the product obtained by multiplying the circumference of each stirrup by the effective depth which was taken to be 5 in.

e. Beam Deflection.- The center deflections of the beams under a load of 40 000 lb. ranged from 0.15 in. to 0.28 in. The beam which deflected 0.15 in. had stirrups of 1/2-in. mild steel spaced 3 in. apart. The beam which deflected 0.28 in. had no stirrups but the longitudinal bars were bent up. One of the beams having stirrups of 1/2-in. mild steel, spaced 6 in. apart, had a center deflection of 0.26 in. For other deflections see tables of original data in back of book.

f. Neutral Axis.- The position of the neutral axis varied considerably for the different beams, the average for all of the beams was about 35% of the effective depth from the top of the beam, under loads of 35 000 lb. to 60 000 lb. The neutral axis in the individual beams also varied. The curves show at the beginning an irregular or adjustment stage. After this stage the curves run fairly uniformly. In general the neutral axis in the T-beams is higher than in a rectangular beam of like depth. The only way the writers can account for the difference in height of the neutral axis in T-beams and rectangular beams is the difference in the quality of concrete from thich they were made.

IV. CONCLUSION.

1. The strength of beam is much increased by using stirrups.

2. The compressive strength of the concrete at the most remote fiber was not developed at the maximum load of the beam.

3. The yield point of the longitudinal reinforcement was not developed at the maximum load of any of the beams.

4. The stirrups did not affect the center deflection of the beams any appreciable amount.

The neutral axis in all of the T-beams was higher than in rectangular beams of similar proportioning, the values ranging from 35% to 40% of the depth of the beam.

5. The vertical stirrups proved to be very effective web reinforcement. The diagonal tension cracks appeared at about the loads at which failure by diagonal tension may be expected in beams without web reinforcement, as was proven with the beams tested without stirrups.

6. The vertical shearing stresses in beams having stirrups spaced 3 in. apart is greater than the vertical shearing unit stresses in beams having stirrups spaced 6 in. apart.

7. The vertical shearing unit stresses in beams having longitudinal reinforcement bent up is less than in beams having stirrups, but is greater than in beams having the longitudinal rods horizontal.

BRIEF REPORT OF T-BEAMS TESTED.

Beam No.	Kind of Reinforcement	Load at First Visible Crack pounds	Maximum Applied Load pounds	Manner of Failure
11	Stirrups 1/2-in. high steel Corrugated bars spaced 6 in. 6, 3/4-in. corrugated bars, horizontal.	40000	44000	One flange broke off.
12	Stirrups 1/2-in. high steel corrugated bars spaced 6 in. 6, 3/4-in. corrugated bars, horizontal.	28000	46200	Flange broke off.
13	Stirrups 1/2-in. mild steel corrugated bars spaced 6 in. 6,3/4-in. corrugated bars, horizontal.	45100	58300	Diagonal Tension.
14	Stirrups 1/2-in. mild steel corrugated bars spaced 6 in. 6, 3/4-in. corrugated bars, horizontal.	39000	57000	Flange broke off.
15	Stirrups 5/8-in. mild steel round rods spaced 6 in. 6, 3/4-in. corrugated bars, horizontal.	35000	58000	One flange broke off at 58000 lb. The other at 47000.
16	Stirrups 5/8-in. mild steel round rods spaced 6 in. 6, 3/4-in. corrugated bars, horizontal.	32000	57600	Diagonal tension.
17	Stirrups 1/4-in. high steel corrugated bars spaced 3 in. 6, 3/4-in. corrugated bars, horizontal.	39000	69000	Diagonal tension.
18	Stirrups 1/4-in. high steel corrugated bars spaced 3 in. 6, 3/4-in. corrugated bars, horizontal.	32000	52000	Diagonal tension.

Continued.

BRIEF REPORT OF T-BEAMS TESTED.

Beam No.	Kind of Reinforcement	Load at First Visible Crack pounds	Maximum Applied Load pounds	Manner of Failure
19	Stirrups 1/4-in. mild steel corrugated bars spaced 3 in. 6, 3/4-in. corrugated bars, horizontal.	35000	60000	Diagonal tension.
20	Stirrups 1/4-in. mild steel corrugated bars spaced 3 in. 6, 3/4-in. corrugated bars,	30000	55000	Diagonal tension.
21	Stirrups 1/2-in. mild steel round rods spaced 3 in. 6, 3/4-in. corrugated bars, horizontal.	36000	69700	Flange broke off.
22	Stirrups 1/2-in. mild steel round rods spaced 3 in. 6, 3/4-in. corrugated bars.	35000	67000	Flange broke off.
23	No stirrups. 6, 3/4-in. corrugated bars, horizontal.	25200	29000	Diagonal tension.
24	No stirrups. 6, 3/4-in. corrugated bars, horizontal.	24000	28000	Diagonal tension.
25	No stirrups. 6, 3/4-in. corrugated bars, bent up.	45200	48000	Diagonal tension.
26	No stirrups. 6, 3/4-in. corrugated bars, bent up.	30000	40000	Diagonal tension.

Concluded.

V. TABLES.

On the following pages are given the original readings and a part of the derived values for beams on which extensometer and dial readings were taken. The first column gives the applied load in pounds and does not include the weight of the beam, or the I-beam, rollers, plates, or instruments used to transfer the load to the 1/3 points. The column headed "deflection" does not contain the original readings from the scale, but instead the deflections from the position of zero load. In the four columns headed "Extensometer Readings" the original readings of the extensometers are given. The columns headed "Dial Readings" do not contain the original readings, but instead the readings computed by subtracting the zero reading from each successive one. Unless otherwise stated in the notes, I and II are always the upper extensometers, and III and IV the lower; I and IV being on one side and II and III on the other.

In the two columns headed "deformation", are given the unit deformations in the upper fiber and the steel. The column marked "k" gives the position of the neutral axis in the per cent of depth of beam from the upper fiber obtainedfrom the Johnson extensometer readings. The neutral axis "k′" is obtained in like manner from the dials. Under "Dial Readings", I is the upper and II is the lower dials.

ORIGINAL DATA

T—beam No. 11

Applied Load pounds	Deflection inches	Johnson Extensometer Readings inches I	II	III	IV	Dial Readings inches I	II
500	.00	.0000	.0000	.0000	.0000	.0000	.0000
5400	.03	.0035	.0025	.0035	.0030	.0033	.0020
10100	.05	.0055	.0055	.0080	.0070	.0072	.0080
15300	.08	.0095	.0105	.0154	.0142	.0113	.0152
20200	.10	.0149	.0150	.0225	.0218	.0163	.0220
25000	.14	.0198	.0200	.0303	.0285	.0231	.0310
30000	.19	.0248	.0250	.0380	.0360	.0274	.0370
35000	.22	.0300	.0305	.0452	.0432	.0343	.0472
40000	.26	.0345	.0365	.0523	.0513	.0413	.0544
44000		Flange broke off.					

COMPUTED DATA

T- beam No. 11

Applied Load pounds	Johnson Extensometer Readings Unit Deformation Upper Fiber	Steel	Neutral Axis k	Dial Readings Unit Deformation Upper Fiber	Steel	Neutral Axis k'
500	.00000	.00000		.00000	.00000	
5400	.00005	.00004	.54	.00006	.00007	.65
10100	.00008	.00012	.40	.00010	.00012	.45
15300	.00014	.00024	.37	.00014	.00022	.37
20200	.00020	.00035	.36	.00019	.00033	.37
25000	.00028	.00047	.37	.00026	.00050	.34
30000	.00035 ✓	.00059 ✓	.38	.00031	.00061	.33 .37
35000	.00042	.00070	.38	.00041	.00070	.36
40000	.00050 ✓	.00082 ✓	.38	.00051	.00080	.39 ✓

ORIGINAL DATA

T-beam No. 12

Applied Load pounds	Deflection inches	Johnson Extensometer Readings inches				Dial Readings inches	
		I	II	III	IV	I	II
2000	.00	.0000	.0000	.0000	.0000	.0000	.0000
5000	.02	.0022	.0015	.0020	.0025	.0010	.0002
10000	.05	.0062	.0040	.0080	.0076	.0050	.0050
15000	.08	.0120	.0082	.0152	.0150	.0090	.0132
20000	.11	.0165	.0148	.0225	.0225	.0160	.0202
25000	.14	.0205	.0200	.0302	.0300	.0230	.0290
30000	.18	.0260	.0260	.0380	.0375	.0290	.0360
35000	.25	.0278	.0324	.0460	.0450	.0360	.0472
38000	.27	.0365	.0362	.0505	.0500	.0415	.0523
41000	.30	.0410	.0410	.0562	.0550	.0470	.0565
44000	.34	.0455	.0445	.0610	.0600	.0520	.0620
46200	.44	.0584	.0550	.0715	.0660	.0690	.0718

COMPUTED DATA

T-beam No, 12

Applied Load pounds	Johnson Extensometer Readings: Unit Deformation Upper Fiber	Johnson Extensometer Readings: Unit Deformation Steel	Neutral Axis k	Dial Readings: Unit Deformation Upper Fiber	Dial Readings: Unit Deformation Steel	Neutral Axis k′
2000	.00000	.00000		.00000	.00000	
5000	.00002	.00004	.37	.00000	.00000	
10000	.00007	.00012	.35	.00007	.00006	.55
15000	.00014	.00024	.37	.00010	.00021	.35
20000	.00022	.00035	.37	.00020	.00029	.41
25000	.00029	.00048	.37	.00028	.00042	.40
30000	.00039	.00059	.38	.00037	.00051	.43
35000	.00042	.00073	.36	.00044	.0007	.39
38000	.00054	.00077	.41	.00052	.00076	.41
41000	.00061	.00085	.41	.00062	.0008	.44
44000	.00073	.00092	.42	.00070	.00086	.45
46000	.00090	.00099	.47	.00082	.00099	.46

ORIGINAL DATA

T-beam No. 13

Applied Load pounds	Deflection inches	Johnson Extensometer Readings inches			
		I	II	III	IV
700	.00	.0000	.0000	.0000	.0000
3500	.02	.0035	.0035	.0030	.0030
6000	.03	.0056	.0057	.0055	.0065
9800	.05	.0106	.0109	.0060	.0118
12300	.06	.0145	.0143	.0144	.0152
15400	.08	.0205	.0202	.0200	.0208
18400	.10	.0275	.0264	.0260	.0273
21600	.13	.0325	.0285	.0300	.0323
24200	.15	.0330	.0288	.0352	.0375
27400	.18	.0360	.0330	.0405	.0430
30100	.20	.0360	.0373	.0450	.0475
33100	.22	.0364	.0413	.0492	.0525
36000	.25	.0369	.0451	.0543	.0573
39200	.28	.0370	.0488	.0595	.0622
42000	.30	.0375	.0521	.0634	.0665
45100	.34	.0379	.0562	.0685	.0717
48000	.36	.0379	.0599	.0738	.0762
51100	.40	.0379	.0635	.0780	.0810
54000	.43	.0379	.0669	.0825	.0855
57100	.47	.0382	.0706	.0880	.0905
58300	.58	Broke by diagonal tension.			

COMPUTED DATA

T-beam No. 13

Applied Load pounds	Johnson Extensometer Readings inches Unit Deformation Upper Fiber	Steel	Neutral Axis k
700	.00000	.00000	
3500	.00006	.00003	.65
6000	.00009	.00008	.55
9800	.00012	.00012	.50
12300	.00025	.00019	.57
15400	.00036	.00025	.58
18400	.00047	.00033	.59
21600	.00052	.00039	.57
24200	.00051	.00051	.50
27400	.00055	.00059	.48
30100	.00057	.00067	.46
33100	.00060	.00076	.44
36000	.00061	.00085	.42
39200	.00063	.00093	.40
42000	.00064	.00103	.38
45100	.00064	.00111	.37
48000	.00065	.00121	.35
51100	.00066	.00130	.34
54000	.00068	.00137	.33
57100	.00069	.00148	.32
58300			

ORIGINAL DATA

T–beam No. 14

Applied Load pounds	Deflection inches	Johnson Extensometer Readings inches I	II	III	IV	Dial Readings inches I	II
2600	.00	.0000	.0000	.0000	.0000	.0000	.0000
6000	.01	.0018	.0012	.0022	.0025	.0002	.0000
9500	.02	.0052	.0049	.0062	.0060	.0004	.0025
2200	.03	.0074	.0070	.0100	.0100	.0065	.0065
15200	.06	.0100	.0099	.0142	.0143	.0095	.0107
18200	.08	.0129	.0110	.0185	.0185	.0105	.0155
21300	.10	.0162	.0119	.0232	.0232	.0165	.0195
24000	.12	.0188	.0135	.0270	.0257	.0190	.0235
27000	.14	.0220	.0160	.0317	.0315	.0230	.0280
30000	.16	.0253	.0182	.0364	.0362	.0260	.0340
33000	.18	.0260	.0200	.0388	.0388	.0305	.0390
36000	.20	.0293	.0222	.0431	.0430	.0340	.0430
39000	.22	.0322	.0248	.0477	.0475	.0370	.0475
42200	.26	.0364	.0281	.0531	.0525	.0410	.0545
45000	.29	.0400	.0322	.0575	.0570	.0435	.0580
48000	.32	.0433	.0363	.0620	.0612	.0475	.0635
51000	.36	.0470	.0382	.0675	.0665	.0550	.0695
54000	.39	.0528	.0442	.0736	.0670	.0560	.0755
57000	.42	.0570	.0480	.0785	.0762	.0590	.0805

COMPUTED DATA

T—beam No. 14

Applied Load pounds	Johnson Extensometer Readings inches			Dial Readings		
	Unit Deformation Upper Fiber	Unit Deformation Steel	Neutral Axis k	Unit Deformation Upper Fiber	Unit Deformation Steel	Neutral Axis k′
2600	.00000	.00000		.00000	.00000	
6000	.00002	.00004	.30	.00004	.00000	.00
9500	.00008	.00009	.48	.00009	.00001	.85
12200	.00010	.00015	.40	.00015	.00008	.55
15200	.00014	.00023	.38	.00011	.00014	.47
18200	.00016	.00030	.35	.00022	.00024	.30
21300	.00017	.00040	.30	.00024	.00027	.45
24000	.00021	.00040	.32	.00029	.00037	.42
27000	.00023	.00053	.30	.00031	.00040	.43
30000	.00026	.00061	.30	.00037	.00050	.38
33000	.00028	.00066	.29	.00043	.00056	.40
36000	.00036	.00071	.33	.00046	.00063	.41
39000	.00035	.00080	.30	.00048	.00069	.40
42200	.00040	.00088	.31	.00052	.00081	.38
45000	.00046	.00094	.33	.00056	.00086	.38
48000	.00052	.00100	.34	.00069	.00094	.37
51000	.00055	.00110	.33	.00066	.00100	.40
54000	.00066	.00110	.37	.00066	.00110	.37
57000	.00071	.00120	.36	.00066	.00120	.37

ORIGINAL DATA

T-beam No. 15.

Applied Load pounds	Deflection inches	Johnson Extensometer Readings inches I	II	III	IV
1500	.00	.0000	.0000	.0000	.0000
5100	.01	.0018	.0018	.0018	.0025
10000	.03	.0050	.0020	.0072	.0070
15000	.05	.0108	.0055	.0125	.0135
20000	.09	.0154	.0100	.0197	.0205
25000	.12	.0204	.0155	.0264	.0270
30000	.15	.0242	.0208	.0332	.0341
35000	.18	.0250	.0260	.0404	.0412
40000	.22	.0250	.0309	.0470	.0472
45000	.27	.0300	.0362	.0553	.0563
50000	.35	.0368	.0426	.0625	.0638
55000	.42	.0310	.0385	.0652	.0660
58000	Flange broke off on south side.				

COMPUTED DATA

T-beam No. 15

Applied Load pounds	Johnson Extensometer Readings inches Unit Deformation Upper Fiber	Steel	Neutral Axis k
1500	.00000	.00000	
5100	.00003	.00003	.38
10000	.00004	.00012	.23
15000	.00011	.00021	.33
20000	.00016	.00033	.33
25000	.00025	.00042	.37
30000	.00031	.00053	.37
35000	.00033	.00067	.33
40000	.00034	.00079	.30
45000	~~.00020~~ 40	.00098 92	~~.23~~ 30
50000	50	102	.32
55000	37	123	.25 ?

ORIGINAL DATA

T-beam No. 16

Applied Load pounds	Deflection inches	Johnson Extensometer Readings inches			
		I	II	III	IV
1500	.00	.0000	.0000	.0000	.0000
5400	.02	.0040	.0037	.0038	.0047
8600	.04	.0062	.0050	.0070	.0076
12700	.07	.0070	.0056	.0108	.0108
16300	.08	.0090	.0072	.0152	.0150
20500	.09	.0127	.0096	.0209	.0208
24200	.10	.0153	.0103	.0264	.0260
28200	.12	.0200	.0125	.0323	.0318
32000	.15	.0240	.0160	.0380	.0325
36200	.18	.0282	.0200	.0444	.0432
40000	.20	.0325	.0214	.0500	.0492
44000	.25	.0365	.0251	.0561	.0547
48300	.29	.0401	.0295	.0621	.0608
52000	.33	.0452	.0335	.0685	.0672
56000	.38	.0492	.0370	.0747	.0725
57600	.55	Broke by diagonal tension.			

COMPUTED DATA

T-beam No. 16

Applied Load pounds	Johnson Extensometer Readings inches — Unit Deformation: Upper Fiber	Steel	Neutral Axis k
1500	.00000	.00000	
5400	.00007	.00005	.55
8600	.00009	.00010	.47
12700	.00008	.00018	.29
16300	.00009	.00026	.25
20500	.00013	.00036	.26
24200	.00013	.00046	.21
28200	.00016	.00056	.23
32000	.00023	.00059	.28
36200	.00027	.00075	.27
40000	.00029	.00085	.26
44000	.00035	.00094	.27
48300	.00041	.00104	.28
52000	.00043	.00127	.25

ORIGINAL DATA

T-beam No. 17

Applied Load pounds	Deflection inches	Johnson Extensometer Readings inches I	II	III	IV	Dial Readings inches I	II
100	.00	.0000	.0000	.0000	.0000	.0000	.0000
3000	.01	.0013	.0021	.0022	.0020	.0002	.0015
6000	.02	.0032	.0038	.0075	.0050	.0024	.0040
9100	.03	.0054	.0050	.0112	.0078	.0042	.0072
12100	.05	.0075	.0072	.0143	.0125	.0070	.0105
15200	.06	.0098	.0095	.0195	.0152	.0107	.0160
18100	.07	.0120	.0122	.0225	.0178	.0120	.0167
21200	.10	.0140	.0150	.0260	.0218	.0162	.0202
24300	.11	.0150	.0170	.0364	.0238	.0172	.0250
27200	.13	.0160	.0190	.0395	.0272	.0202	.0292
30100	.14	.0180	.0220	.0432	.0305	.0224	.0323
33100	.15	.0205	.0236	.0465	.0345	.0262	.0360
36100	.18	.0222	.0265	.0505	.0380	.0282	.0412
39000	.19	.0305	.0270	.0545	.0415	.0312	.0440
42000	.21	.0280	.0300	.0585	.0445	.0342	.0485
45100	.23	.0310	.0330	.0630	.0499	.0354	.0535
48100	.25	.0334	.0345	.0744	.0526	.0404	.0565
51000	.29	.0355	.0370	.0829	.0562	.0430	.0595
54600	.31	.0380	.0380	.0857	.0613	.0460	.0632
57000	.33	.0400	.0400	.0979	.0655	.0474	.0668
60000	.35	.0412	.0435	.1032	.0685	.0527	.0712
63000	.38	.0440	.0469	.1085	.0730	.0572	.0760
66000	.41	.0430	.0480	.1175	.0765	.0602	.0805
69000		Broke by diagonal tension.					

COMPUTED DATA

T-beam No. 17

Applied Load pounds	Johnson Extensometer Readings: Unit Deformation Upper Fiber	Johnson Extensometer Readings: Unit Deformation Steel	Neutral Axis k	Dial Readings: Unit Deformation Upper Fiber	Dial Readings: Unit Deformation Steel	Neutral Axis k′
100	.00000	.00000		.00000	.00000	
3000	.00003	.00003	.43	.00001	.00003	.35
6000	.00004	.00010	.28	.00002	.00006	.30
9100	.00006	.00016	.27	.00004	.00012	.25
12100	.00008	.00023	.27	.00007	.00017	.30
15200	.00011	.00029	.27	.00012	.00025	.31
18100	.00015	.00033	.31	.00014	.00026	.35
21200	.00018	.00039	.31	.00017	.00036	.33
24300	.00017	.00052	.25	.00019	.00039	.33
27200	.00018	.00058	.24	.00023	.00045	.33
30100	.00022	.00063	.26	.00025	.00049	.33
33100	.00024	.00070	.26	.00031	.00054	.36
36100	.00027	.00076	.26	.00031	.00063	.32
39000	.00036	.00080	.31	.00036	.00073	.34
42000	.00031	.00088	.28	.00039	.00073	.35
45100	.00037	.00096	.28	.00037	.00084	.30
48100	.00037	.00111	.25	.00046	.00086	.34
51000	.00038	.00121	.24	.00050	.00089	.36
54000	.00039	.00125	.24	.00054	.00094	.37
57000	.00039	.00145	.21	.00054	.00101	.35
60000	.00043 30	.00151	.22 20	.00063	.00106	.37
63000	.00045	.00159	.22	.00070	.00112	.38
66000	.00046	.00173	.20	.00071	.00121	.36

ORIGINAL DATA

T—beam No. 18

Applied Load pounds	Deflection inches	Johnson Extensometer Readings inches				Dial Readings inches	
		I	II	III	IV	I	II
4000	.01	.0040	.0005	.0035	.0050	.0020	.0040
8000	.04	.0055	.0032	.0067	.0082	.0040	.0095
12000	.06	.0088	.0070	.0115	.0135	.0080	.0160
16000	.08	.0125	.0104	.0169	.0192	.0135	.0230
20000	.11	.0155	.0137	.0222	.0246	.0160	.0300
24000	.13	.0195	.0175	.0272	.0295	.0210	.0341
28000	.16	.0234	.0213	.0331	.0353	.0250	.0382
32000	.18	.0270	.0245	.0385	.0406	.0290	.0445
36000	.22	.0310	.0280	.0445	.0463	.0348	.0509
40000	.26	.0342	.0300	.0506	.0495	.0382	.0542
44000	.28	.0375	.0305	.0562	.0530	.0432	.0605
48000	.33	.0420	.0347	.0620	.0586	.0482	.0665
52000	.37	.0485	.0352	.0675	.0638	.0540	.0718

COMPUTED DATA

T-beam No. 18

Applied Load pounds	Johnson Extensometer Readings: Unit Deformation Upper Fiber	Johnson Extensometer Readings: Unit Deformation Steel	Neutral Axis k	Dial Readings: Unit Deformation Upper Fiber	Dial Readings: Unit Deformation Steel	Neutral Axis k′
4000	.00003	.00007	.26	.00001	.00007	.16
8000	.00003	.00013	.18	.00001	.00017	.10
12000	.00010	.00020	.33	.00004	.00030	.12
16000	.00015	.00029	.33	.00011	.00038	.24
20000	.00019	.00039	.33	.00012	.00051	.19
24000	.00025	.00045	.36	.00019	.00055	.26
28000	.00031	.00055	.36	.00026	.00060	.30
32000	.00035	.00083	.35	.00029	.00071	.29
36000	.00040	.00073	.35	.00038	.00079	.32
40000	.00042	.00083	.33	.00043	.00083	.34
44000	.00044	.00089	.33	.00050	.00092	.35
48000	.00050	.00099	.33	.00057	.00099	.36
52000	.00054	.00108	.33	.00066	.00106	.38

ORIGINAL DATA

T–beam No. 19

Applied Load pounds	Deflection inches	Johnson Extensometer Readings inches				Dial Readings inches	
		I	II	III	IV	I	II
100	.00	.0000	.0000	.0000	.0000	.0000	.0000
5300	.01	.0019	.0012	.0035	.0041	.0010	.0020
10200	.03	.0050	.0073	.0080	.0066	.0062	.0055
15300	.08	.0105	.0112	.0145	.0130	.0110	.0120
20100	.11	.0184	.0158	.0201	.0141	.0130	.0200
25100	.12	.0185	.0205	.0279	.0140	.0215	.0280
30000	.16	.0238	.0250	.0345	.0157	.0260	.0358
35000	.19	.0230	.0248	.0415	.0207	.0320	.0380
40000	.23	.0275	.0295	.0465	.0215	.0370	.0500
45100	.28	.0329	.0350	.0535	.0357	.0420	.0580
50000		.0374	.0399	.0608	.0425	.0500	.0660
55000	.33	.0430	.0450	.0680	.0504	.0550	.0750
60000							

This reading seems to be wrong.

COMPUTED DATA

T-beam No. 19

Applied Load pounds	Johnson Extensometer Readings: Unit Deformation Upper Fiber	Steel	Neutral Axis k	Dial Readings: Unit Deformation Upper Fiber	Steel	Neutral Axis k′
1000	.00000	.00000		.00000	.00000	
5300	.00001	.00007	.15	.00003	.00003	.26
10200	.00010	.00010	.50	.00010	.00006	.60
15300	.00016	.00020	.46	.00016	.00016	.50
20100	.00030	.00025	.58	.00020	.00031	.30
25100	.00033	.00027	.55	.00026	.00041	.38
30000	.00043	.00032	.56	.00031	.00053	.36
35000	.00036	.00046	.44	.00043	.00053	.45
40000	.00046	.00048	.49	.00044	.00075	.36
45100	.00052	.00067	.43	.00048	.00087	.35
50000	.00058	.00075	.43	.00061	.00097	.38
55000	.00066	.00090	.42	.00065	.00113	.36

ORIGINAL DATA

T-beam No. 20

Applied Load pounds	Deflection inches	Johnson Extensometer Readings inches				Dial Readings inches	
		I	II	III	IV	I	II
2000	.00	.0000	.0000	.0000	.0000	.0000	.0000
5000	.01	.0025	.0025	.0040	.0032	.0011	.0020
10000	.05	.0060	.0058	.0110	.0088	.0058	.0080
15000	.06	.0105	.0105	.0180	.0155	.0101	.0160
20000	.09	.0150	.0155	.0255	.0235	.0161	.0220
25000	.13	.0140	.0205	.0333	.0300	.0218	.0310
30000	.17	.0050	.0255	.0415	.0375	.0281	.0410
35000	.20	.0050	.0310	.0500	.0440	.0344	.0480
40000	.24	.0060	.0370	.0580	.0500	.0406	.0560
45000	.27	.0080	.0425	.0658	.0565	.0476	.0630
50000	.33	.0130	.0490	.0735	.0638	.0546	.0710
55000	.39	.0150	.0560	.0815	.0710	.0616	.0790

COMPUTED DATA

T-beam No. 20

Applied Load pounds	Johnson Extensometer Readings inches: Unit Deformation Upper Fiber	Johnson Extensometer: Unit Deformation Steel	Neutral Axis k	Dial Readings: Unit Deformation Upper Fiber	Dial Readings: Unit Deformation Steel	Neutral Axis k′
2000	.00000	.00000		.00000	.00000	
5000	.00003	.00006	.36	.00001	.00003	.15
10000	.00007	.00017	.29	.00006	.00012	.36
15000	.00013	.00027	.32	.00009	.00026	.27
20000	.00019	.00041	.32	.00019	.00033	.36
25000	.00026	.00054	.25	.00025	.00047	.34
30000	.00033	.00061	.34	.00030	.00065	.31
35000	.00047	.00065	.43	.00039	.00073	.35
40000	.00056	.00071	.44	.00046	.00085	.35
45000	.00065	.00081	.44	.00057	.00093	.37
50000	.00076	.00090	.46	.00067	.00104	.39
55000	.00088 ?	.00100 ?	.47	.00073	.00116	.40

ORIGINAL DATA

T–beam No. 21

Applied Load pounds	Deflection inches	Johnson Extensometer Readings inches				Dial Readings inches	
		I	II	III	IV	I	II
3400	.00	.0000	.0000	.0000	.0000	.0000	.0000
8000	.01	.0033	.0005	.0045	.0045	.0025	.0040
12000	.03	.0064	.0005	.0090	.0082	.0047	.0080
15200	.04	.0100	.0015	.0138	.0145	.0065	.0138
20000	.05	.0140	.0050	.0195	.0200	.0105	.0195
24000	.06	.0153	.0086	.0248	.0250	.0145	.0259
28000	.07	.0218	.0125	.0250	.0308	.0225	.0300
32000	.11	.0265	.0166	.0362	.0372	.0305	.0378
36000	.13	.0300	.0211	.0423	.0433	.0335	.0445
40000	.15	.0349	.0255	.0481	.0485	.0375	.0510
44000	.16	.0395	.0300	.0543	.0550	.0455	.0580
48000	.19	.0442	.0340	.0605	.0607	.0495	.0645
52000	.21	.0492	.0395	.0656	.0665	.0565	.0720
56000	.29	.0550	.0450	.0726	.0747	.0625	.0790
60000	.33	.0580	.0502	.0795	.0813	.0665	.0850
64000	.35	.0660	.0555	.0862	.0883	.0735	.0925
68000	.43	.0730	.0618	.0932	.0955	.0805	.0102
69700		Flange broke off.					

COMPUTED DATA

T–beam No. 21

Applied Load pounds	Johnson Extensometer Readings: Unit Deformation Upper Fiber	Johnson Extensometer Readings: Unit Deformation Steel	Neutral Axis k	Dial Readings: Unit Deformation Upper Fiber	Dial Readings: Unit Deformation Steel	Neutral Axis k′
3400	.00000	.00000		.00000	.00000	
8000	.00000	.00000		.00000	.00000	
12000	.00013	.00083	.15	.00027	.00073	.26
16200	.00020	.00160	.10	.00040	.00103	.21
20000	.00037	.00026	.12	.00033	.00058	.12
24000	.00090	.00035	.20	.00080	.00033	.20
28000	.00110	.00044	.21	.00117	.00044	.20
32000	.00022	.00046	.32	.00028	.00044	.37
36000	.00027	.00061	.30	.00040	.00053	.42
40000	.00038	.00071	.31	.00041	.00066	.38
44000	.00039	.00080	.32	.00045	.00077	.36
48000	.00046	.00089	.34	.00058	.00084	.40
52000	.00053	.00097	.35	.00061	.00085	.38
56000	.00061 69	.00106 117	.37	.00071	.00103	.40
60000	.00070	.00116	.37	.00079	.00114	.41
64000	.00074	.00128	.37	.00083	.00123	.40
68000	.00087	.00136	.39	.00095	.00131	.42
69700	.00100	.00143	.41	.00104	.00146	.41

ORIGINAL DATA

T-beam No. 22

Applied Load pounds	Deflec- tion inches	Johnson Extensometer Readings inches				Dial Readings inches	
		I	II	III	IV	I	II
1100	.00	.0000	.0000	.0000	.0000	.0000	.0000
5000	.00	.0038	.0025	.0048	.0040	.0000	.0000
10000	.02	.0078	.0062	.0102	.0100	.0050	.0062
15000	.03	.0120	.0100	.0175	.0170	.0050	.0127
20000	.05	.0175	.0155	.0265	.0255	.0150	.0212
25000	.06	.0220	.0160	.0335	.0325	.0180	.0272
30000	.07	.0240	.0170	.0410	.0400	.0260	.0362
35000	.15	.0241	.0225	.0492	.0480	.0370	.0442
– 40000	.20	.0241	.0290	.0570	.0555	.0390	.0522
45000	.27	.0241	.0320	.0646	.0635	.0450	.0612
– 50000	.31	.0241	.0330	.0727	.0710	.0520	.0684
55000	.33	.0241	.0335	.0812	.0790	.0600	.0767
– 60000	.38	.0241	.0345	.0900	.0875	.0690	.0872
65000	.47	.0241	.0370	.1150	.0975	.0780	.0982
67000		Flange failed.					

↳ stiffening?

COMPUTED DATA

T-beam No. 22

Applied Load pounds	Johnson Extensometer Readings inches			Dial Readings		
	Unit Deformation		Neutral	Unit Deformation		Neutral
	Upper Fiber	Steel	Axis k	Upper Fiber	Steel	Axis k
1100	.00000	.00000		.00000	.00000	
5000	.00005	.00006	.40	.00000	.00000	.00
10000	.00010	.00016	.38	.00006	.00009	.46
15000	.00015	.00020	.34	.00006	.00023	.00
20000	.00021	.00042	.34	.00016	.00032	.34
25000	.00023	.00056	.28	.00019	.00043	.30
30000	.00021	.00071	.22	.00030	.00055	.35
35000	.00019	.00088	.17	.00037	.00066	.35
40000	.00029	.00100	.23	.00046	.00078	.37
45000	.00031	.00110	.22	.00053	.00092	.37
50000	.00027	.00130	.17	.00063	.00100	.38
55000	.00022	.00150	.13	.00075	.00110	.41
60000	.00017	.00170	.09	.00087	.00120	.41
65000	.00013	.00190	.07	.00092	.00160	.38
67000						

ORIGINAL DATA

T-beam No. 23

Applied Load pounds	Deflection inches	Johnson Extensometer Readings inches			
		I	II	III	IV
5600	.02	.0010	.0009	.0015	.0020
10300	.04	.0035	.0030	.0045	.0050
15600	.06	.0080	.0064	.0110	.0110
20400	.09	.0105	.0085	.0164	.0173
25200	.12	.0145	.0118	.0232	.0238
29000					

COMPUTED DATA

T-beam No. 23.

Applied Load pounds	Johnson Extensometer Readings Unit Deformation Upper Fiber	Steel	Neutral Axis. k
5600	.00001	.00006	.25
10300	.00005	.00007	.30
15600	.00004	.00018	.36
20400	.00010	.00027	.29
23200	.00015	.00040	.26

ORIGINAL DATA

T-beam No. 24

Applied Load pounds	Deflection inches	Johnson Extensometer Readings inches I	II	III	IV
1000	.00	.0000	.0000	.0000	.0000
3000	.02	.0015	.0015	.0015	.0045
6000	.03	.0014	.0038	.0245	.0245
9000	.04	.0150	.0059	.0152	.0245
12000	.05	.0130	.0090	.0195	.0775
15000	.06	.0105	.0119	.0250	.0898
18000	.07	.0080	.0145	.0300	.0945
21000	.09	.0050	.0170	.0345	.0995
24000	.13	.0020	.0202	.0392	.1045
27000	.15	.0012	.0230	.0440	.1090
28000		Broke by diagonal tension.			

COMPUTED DATA

T—beam No. 24

Applied Load pounds	Johnson Extensometer Readings inches Unit Deformation Upper Fiber	Steel	Neutral Axis k
1000	.00000	.00000	
3000	.00002	.00005	.20
6000	.00000	.00028	.00
9000	.00012	.00032	.27
12000	.00013	.00033	.27
15000	.00009	.00046	.16
18000	.00013	.00054	.20
21000	.00016	.00061	.21
24000	.00021	.00069	.23
27000	.00025	.00077	.24
28000			

ORIGINAL DATA

T–beam No. 25

Applied Load pounds	Deflection inches.	Johnson Extensometer Readings inches I	II	III	IV
0	0	0	0	0	0
5500	.01	.0021	.0025	.0045	.0045
10600	.02	.0040	.0058	.0080	.0080
15200	.06	.0072	.0095	.0135	.0135
20100	.08	.0115	.0135	.0210	.0200
25100	.11	.0150	.0178	.0271	.0280
30100	.16	.0190	.0220	.0342	.0350
35000	.18	.0218	.0240	.0350	.0468
40200	.24	.0305	.0327	.0355	.0590
45200	.30	.0368	.0382	.0364	.0655
48000	.36	Broke by diagonal tension.			

COMPUTED DATA

T—beam No. 25

Applied Load pounds	Johnson Extensometer Readings inches Unit Deformation Upper Fiber	Steel	Neutral Axis k
5500	.00002	.00008	.24
10600	.00006	.00013	.32
15200	.00009	.00024	.29
20100	.00016	.00034	.32
25100	.00020	.00046	.31
30100	.00025	.00058	.30
35000	.00026	.00069	.27
40200	.00043	.00075	.37
45200	.00056	.00078	.41

ORIGINAL DATA

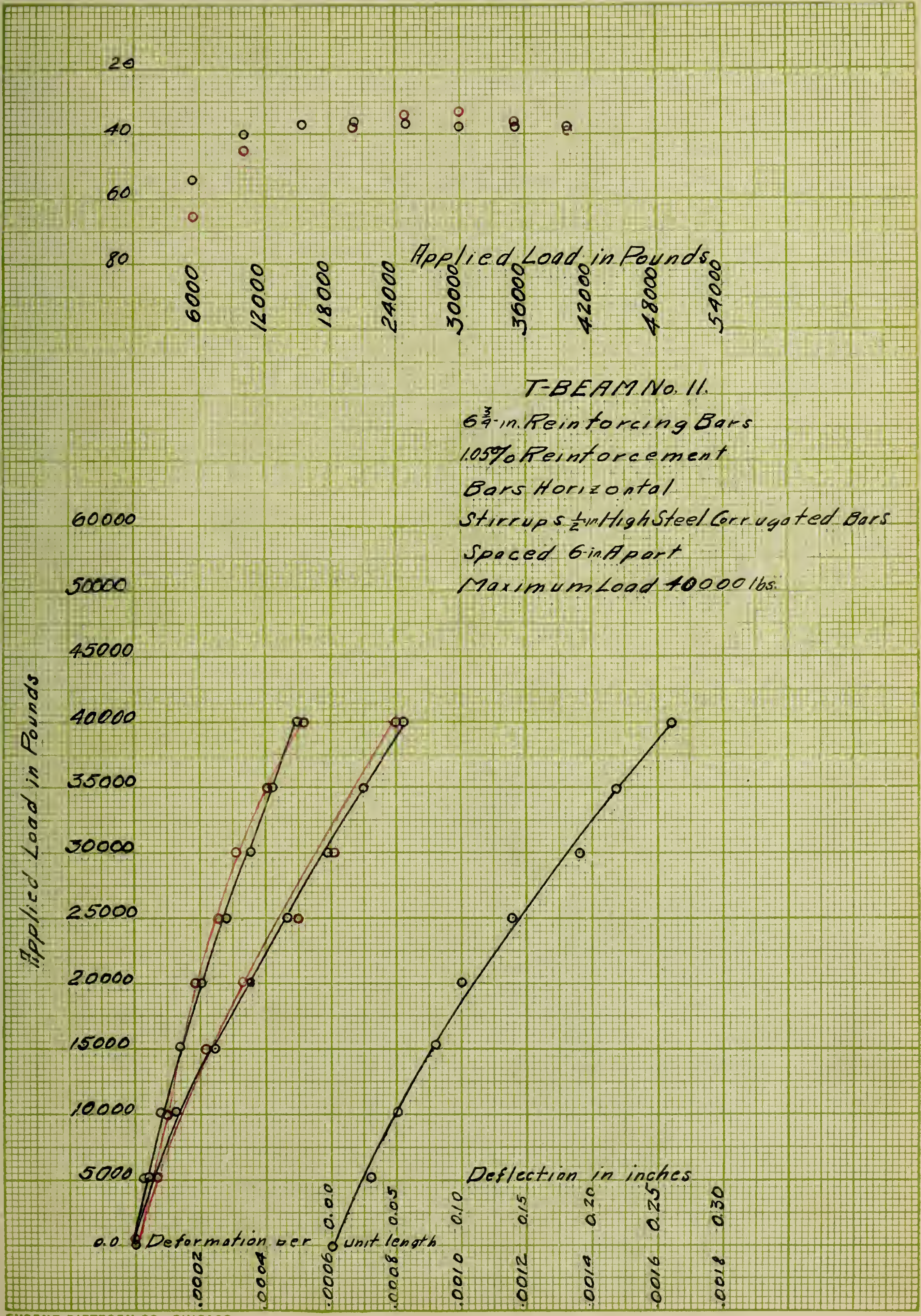
T-beam No. 26

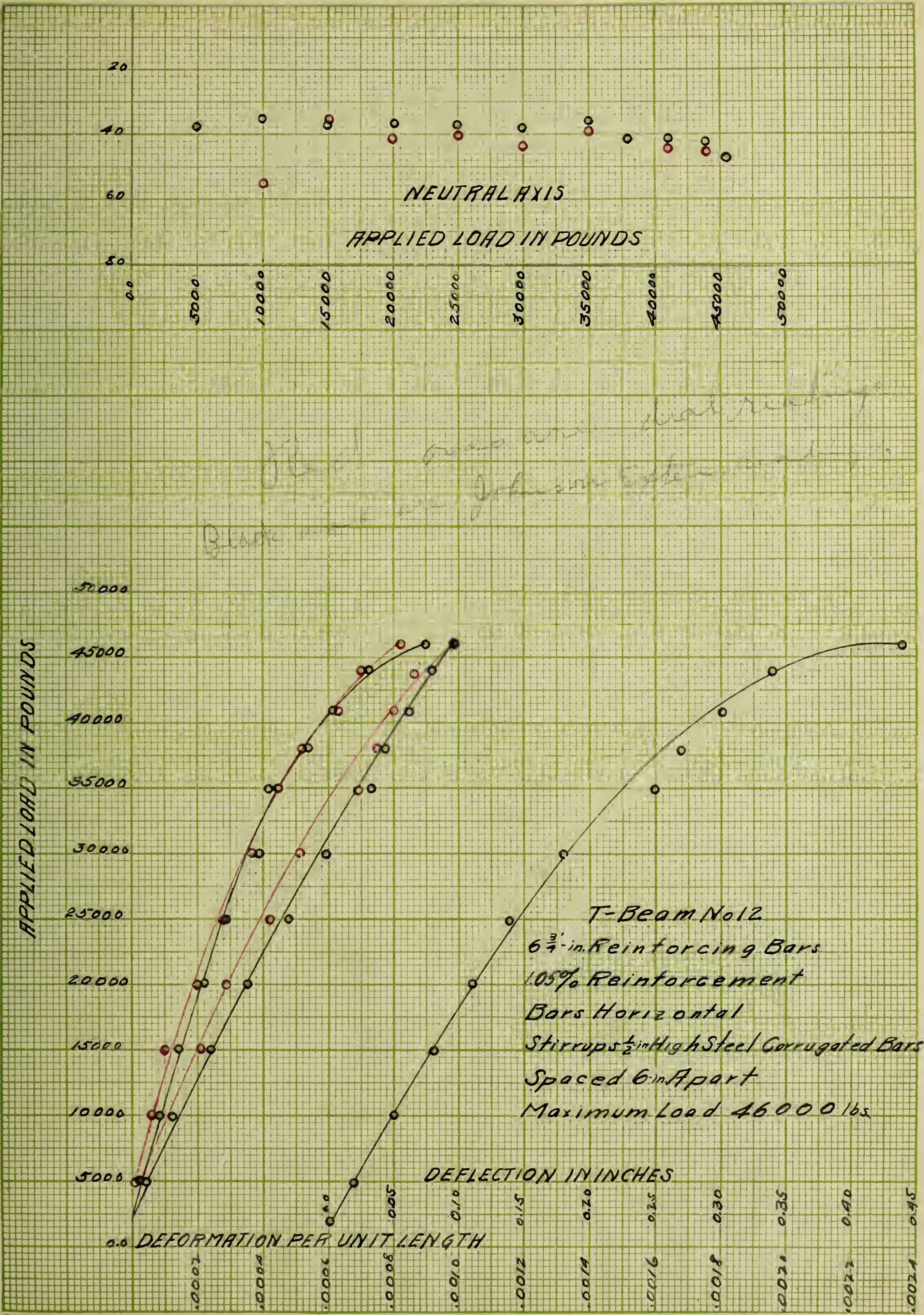
Applied Load pounds	Deflection inches	Johnson Extensometer Readings inches				Dial Readings inches	
		I	II	III	IV	I	II
2000	.00	.0000	.0000	.0000	.0000	.0000	.0000
5000	.02	.0017	.0025	.0025	.0030	.0000	.0000
10000	.05	.0052	.0055	.0069	.0070	.0000	.0070
15000	.07	.0100	.0095	.0125	.0135	.0050	.0130
20000	.10	.0150	.0145	.0200	.0208	.0090	.0200
25000	.13	.0180	.0195	.0270	.0275	.0100	.0270
30000	.15	.0187	.0240	.0348	.0348	.0220	.0340
35000	.21	.0190	.0245	.0410	.0420	.0280	.0440
40000	.28	.0190	.0250	.0475	.0485	.0340	.0520

COMPUTED DATA

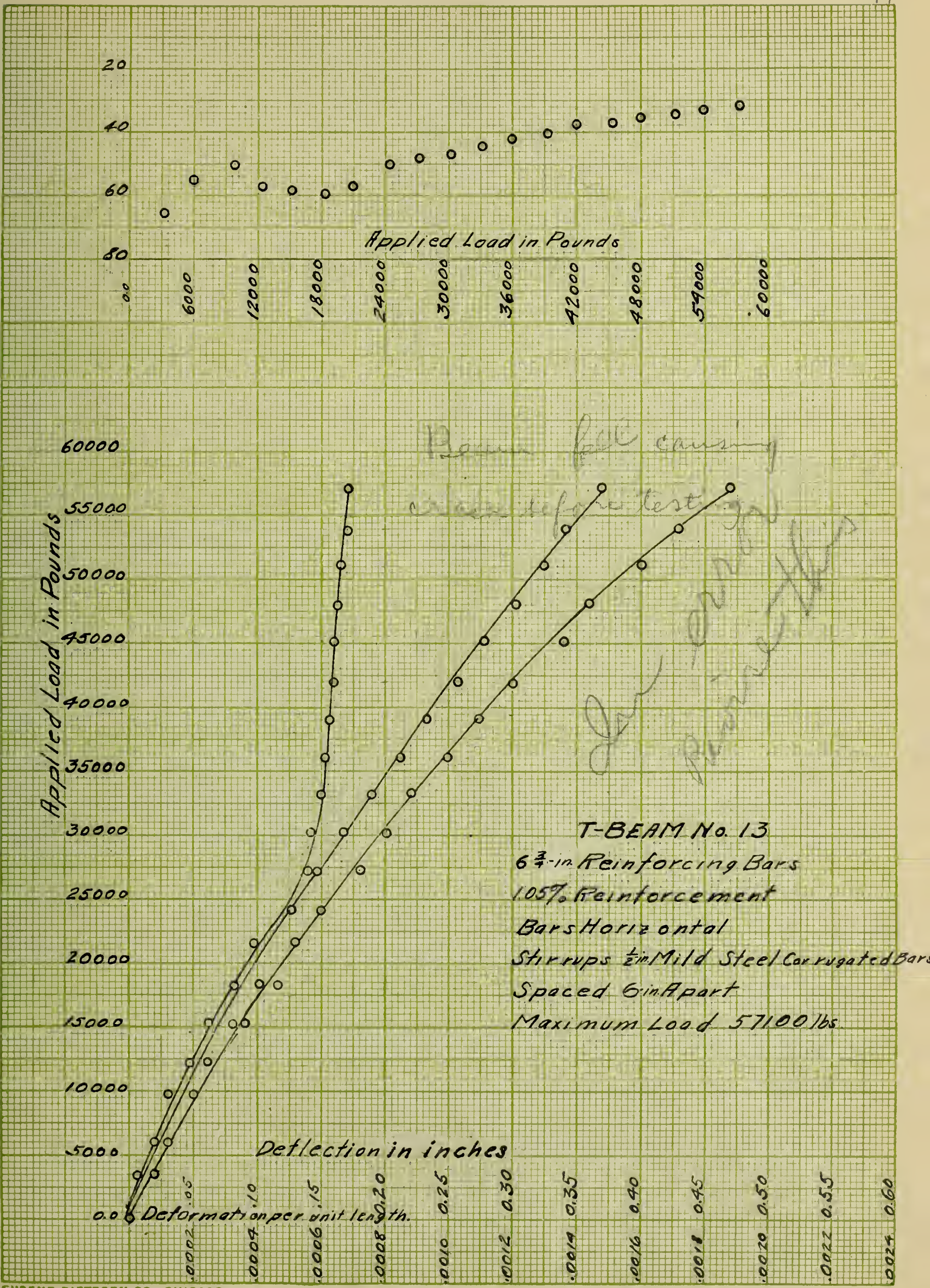
T-beam No. 26

Applied Load pounds	Johnson Extensometer Readings			Dial Readings		
	Unit Deformation		Neutral Axis k	Unit Deformation		Neutral Axis k′
	Upper Fiber	Steel		Upper Fiber	Steel	
2000	.00000	.00000	.00	.00000	.00000	.00
5000	.00004	.00004	.45	.00000	.00000	.00
10000	.00008	.00010	.43	.00000	.00015	.00
15000	.00015	.00016	.42	.00000	.00029	.00
20000	.00021	.00032	.40	.00004	.00030	.10
25000	.00026	.00043	.38	.00013	.00045	.24
30000	.00027	.00058	.31	.00021	.00054	.28
35000	.00022	.00073	.24	.00027	.00071	.27
40000	.00028	.00087	.16	.00030	.00082	.29

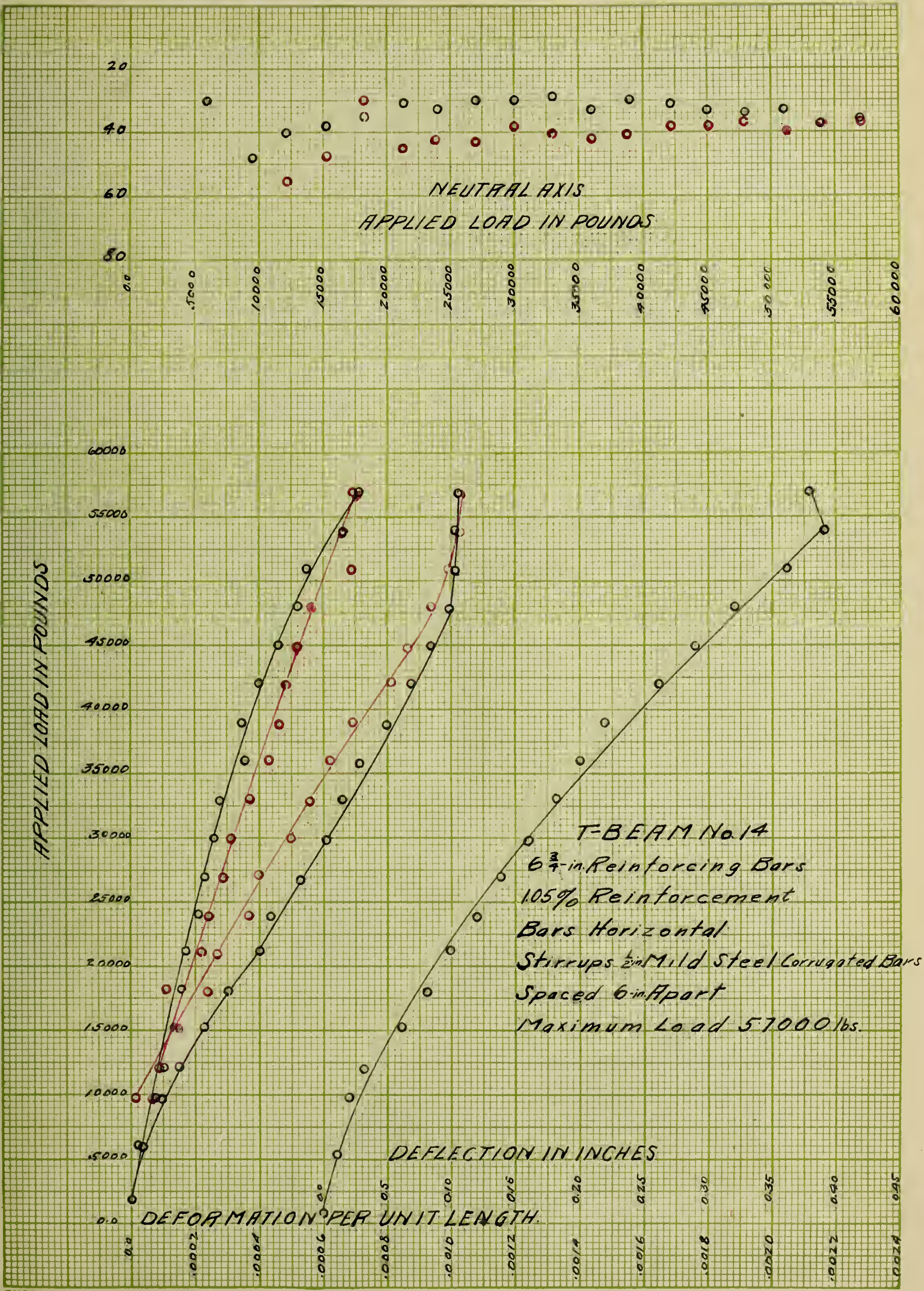

T-BEAM No. 11.
6 ¾-in. Reinforcing Bars
1.05% Reinforcement
Bars Horizontal
Stirrups ½-in High Steel Corrugated Bars
Spaced 6-in. Apart
Maximum Load 40000 lbs.
Applied Load in Pounds
20
40
60
80
6000
12000
18000
24000
30000
36000
42000
48000
54000
Applied Load in Pounds
60000
50000
45000
40000
35000
30000
25000
20000
15000
10000
5000
0.0
Deformation per unit length
.0002
.0004
.0006
.0008
.0010
.0012
.0014
.0016
.0018
Deflection in inches
0.00
0.05
0.10
0.15
0.20
0.25
0.30

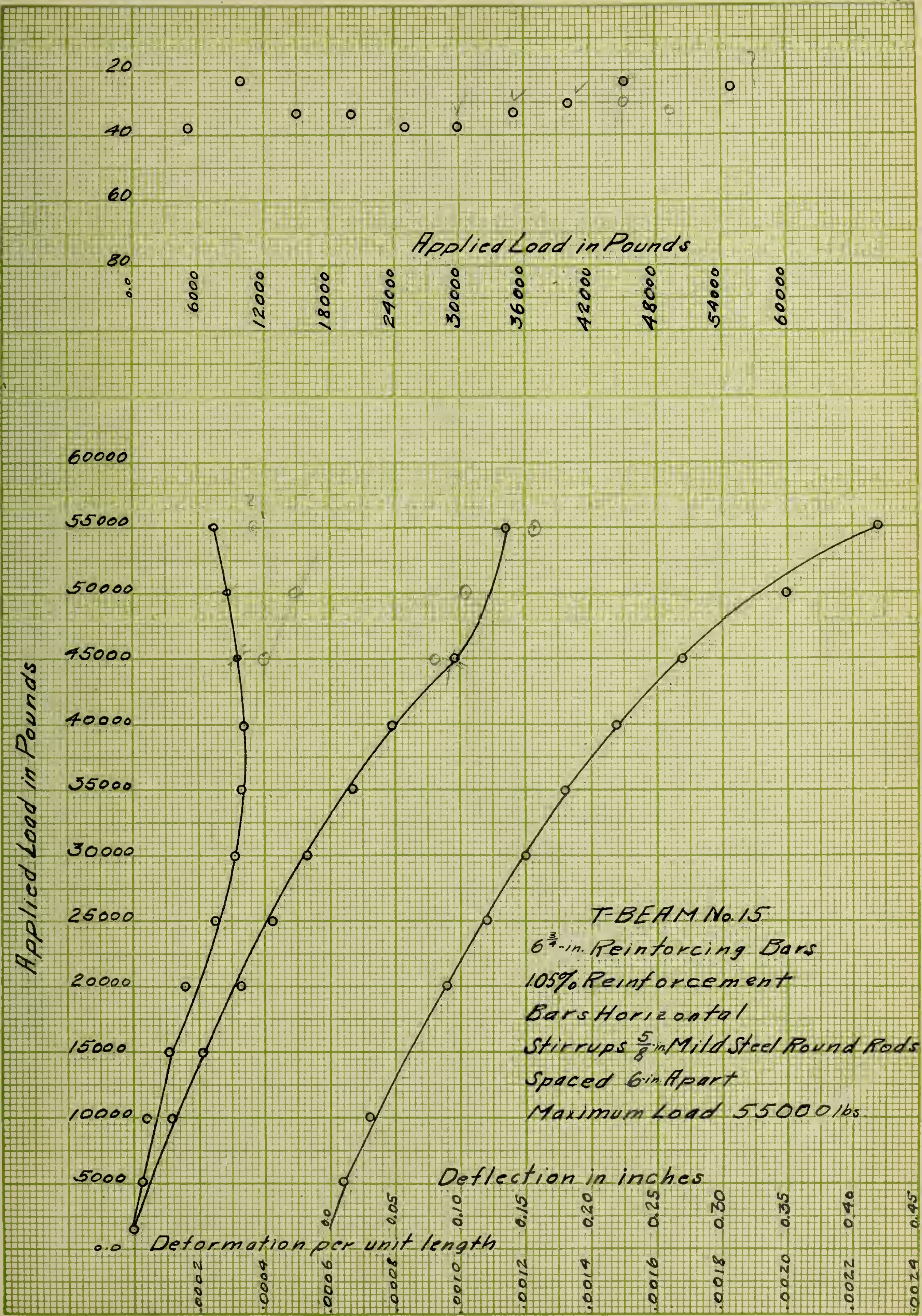


20
40
60
80
NEUTRAL AXIS
APPLIED LOAD IN POUNDS
0.0
5000
10000
15000
20000
25000
30000
35000
40000
45000
50000
APPLIED LOAD IN POUNDS
50000
45000
40000
35000
30000
25000
20000
15000
10000
5000
0.0
T-Beam No 12
6 3/4-in. Reinforcing Bars
1.05% Reinforcement
Bars Horizontal
Stirrups 1/2 in High Steel Corrugated Bars
Spaced 6 in Apart
Maximum Load 46000 lbs.
DEFLECTION IN INCHES
0.0
0.05
0.10
0.15
0.20
0.25
0.30
0.35
0.40
0.45
DEFORMATION PER UNIT LENGTH
.0002
.0004
.0006
.0008
.0010
.0012
.0014
.0016
.0018
.0020
.0022
.0024

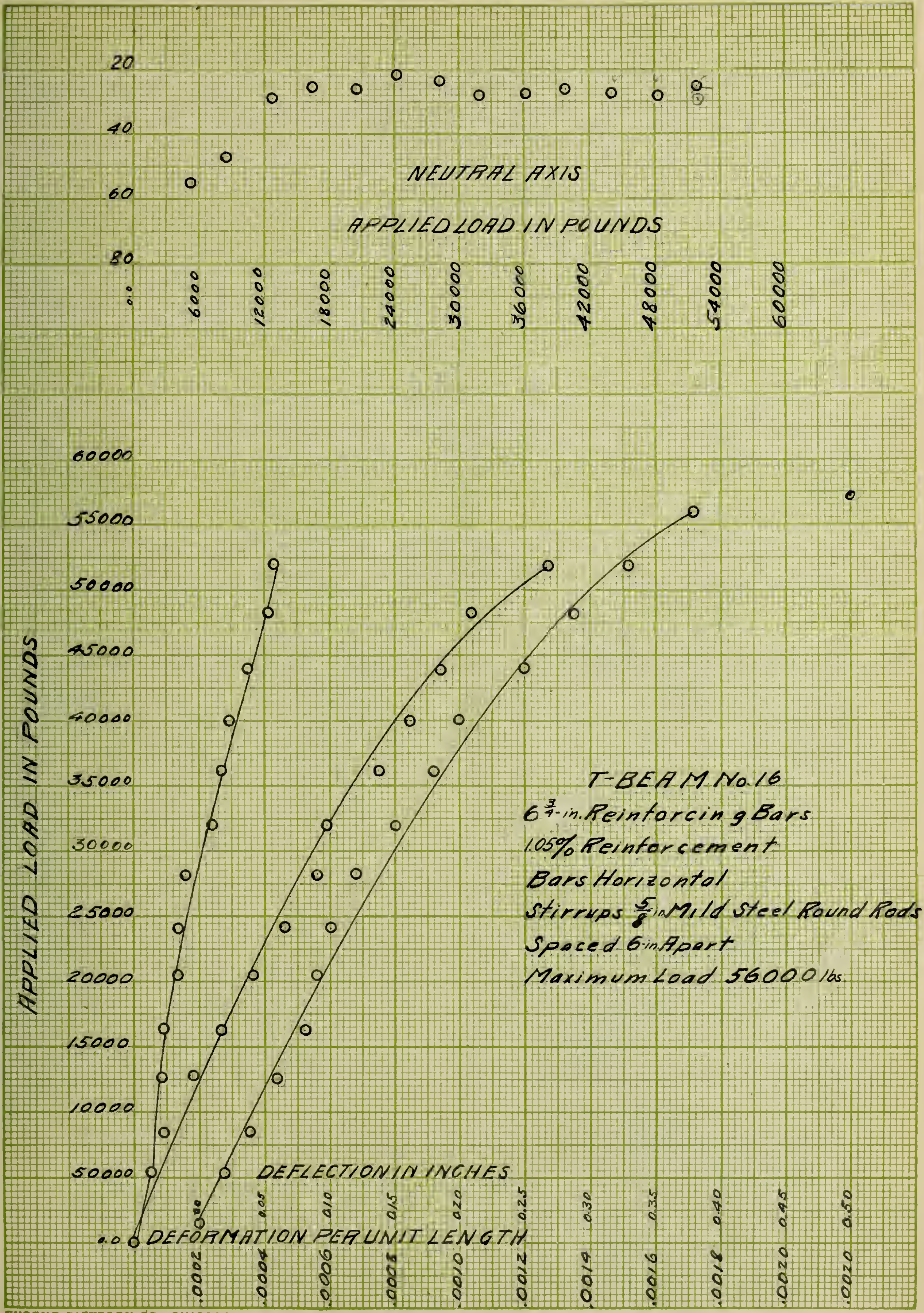


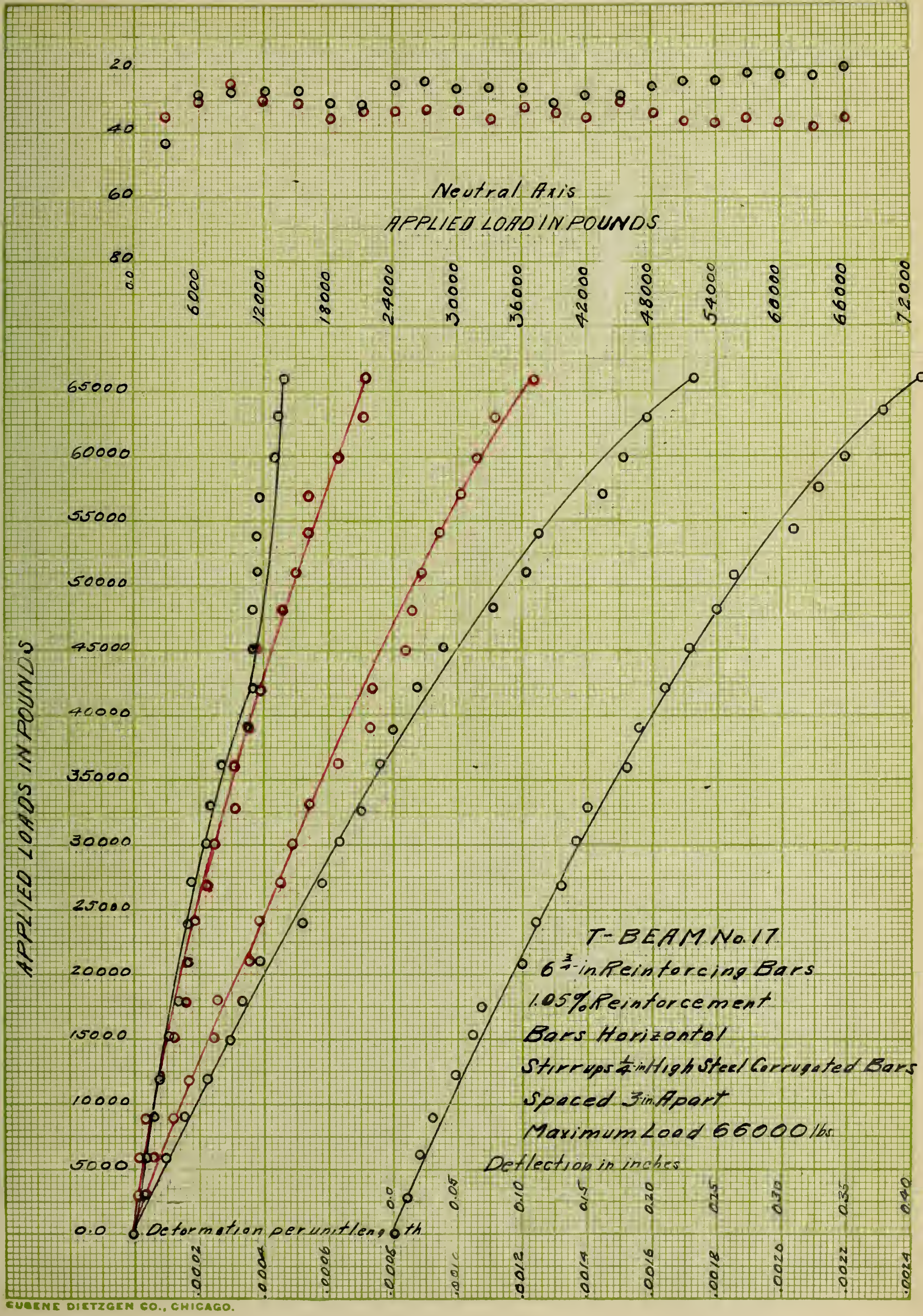
20
40
60
80
Applied Load in Pounds
0.0
6000
12000
18000
24000
30000
36000
42000
48000
54000
60000
60000
55000
50000
45000
40000
35000
30000
25000
20000
15000
10000
5000
Applied Load in Pounds
T-BEAM No. 13
6 ¾-in Reinforcing Bars
1.05% Reinforcement
Bars Horizontal
Stirrups ½ in Mild Steel Corrugated Bars
Spaced 6 in Apart
Maximum Load 57100 lbs.
Deflection in inches
0.0
Deformation per unit length.
.05
.10
.15
0.20
0.25
0.30
0.35
0.40
0.45
0.50
0.55
0.60
.0002
.0004
.0006
.0008
.0010
.0012
.0014
.0016
.0018
.0020
.0022
.0024


NEUTRAL AXIS
APPLIED LOAD IN POUNDS
20
40
60
80
0.0
5000
10000
15000
20000
25000
30000
35000
40000
45000
50000
55000
60000
APPLIED LOAD IN POUNDS
60000
55000
50000
45000
40000
35000
30000
25000
20000
15000
10000
5000
0.0
T-BEAM No. 14
6 ¾-in. Reinforcing Bars
1.05% Reinforcement
Bars Horizontal
Stirrups ½-in. Mild Steel Corrugated Bars
Spaced 6-in. Apart
Maximum Load 57000 lbs.
DEFLECTION IN INCHES
0.0
0.05
0.10
0.15
0.20
0.25
0.30
0.35
0.40
0.45
DEFORMATION PER UNIT LENGTH.
0.0
.0002
.0004
.0006
.0008
.0010
.0012
.0014
.0016
.0018
.0020
.0022
.0024

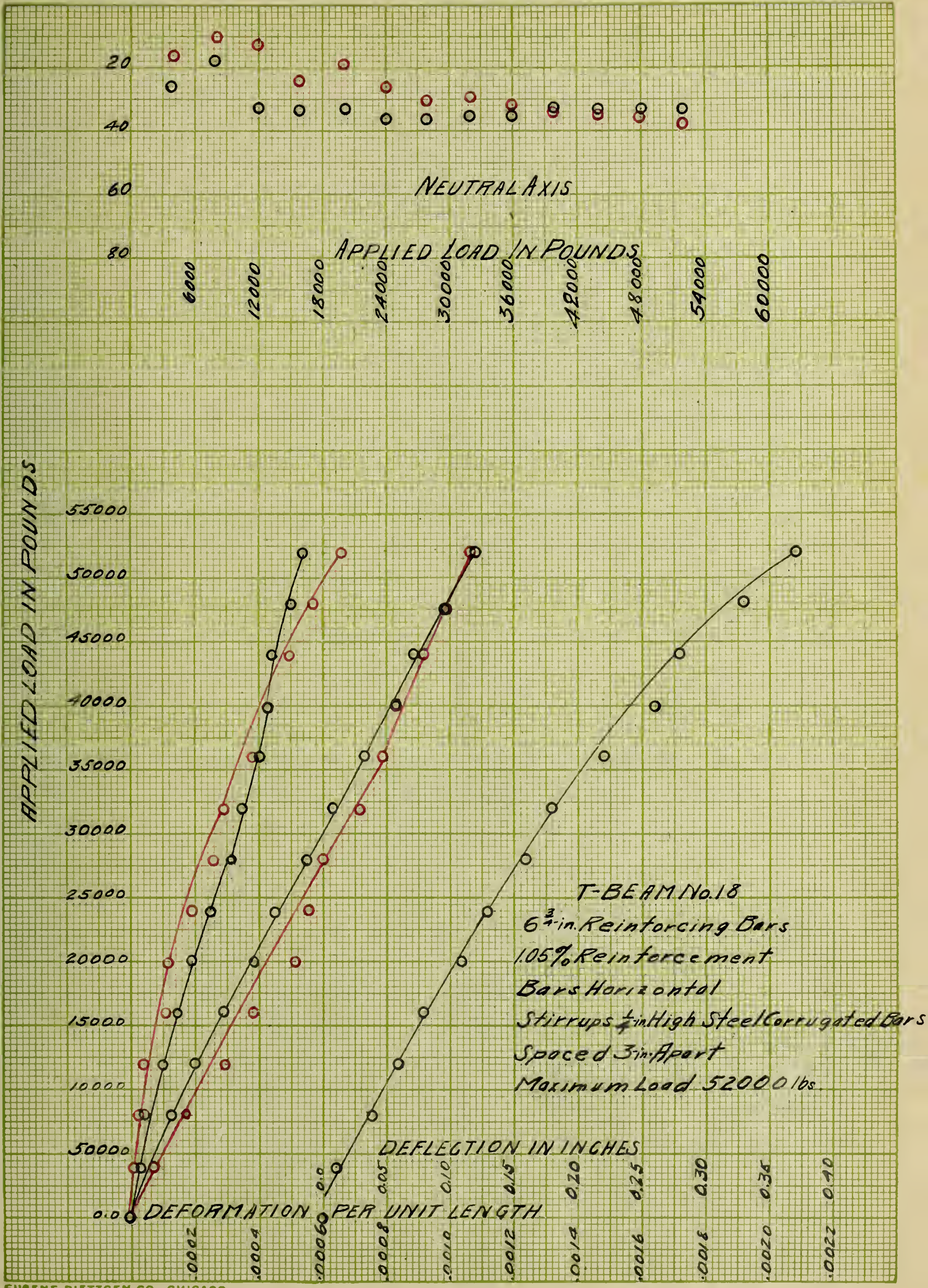


20
40
60
80
Applied Load in Pounds
0.0
6000
12000
18000
24000
30000
36000
42000
48000
54000
60000
60000
55000
50000
45000
40000
35000
30000
25000
20000
15000
10000
5000
0.0
Applied Load in Pounds
T-BEAM No. 15
6 3/4-in. Reinforcing Bars
1.05% Reinforcement
Bars Horizontal
Stirrups 5/8 in. Mild Steel Round Rods
Spaced 6 in. Apart
Maximum Load 55000 lbs.
Deflection in inches
0.0
0.05
0.10
0.15
0.20
0.25
0.30
0.35
0.40
0.45
Deformation per unit length
.0002
.0004
.0006
.0008
.0010
.0012
.0014
.0016
.0018
.0020
.0022
.0024

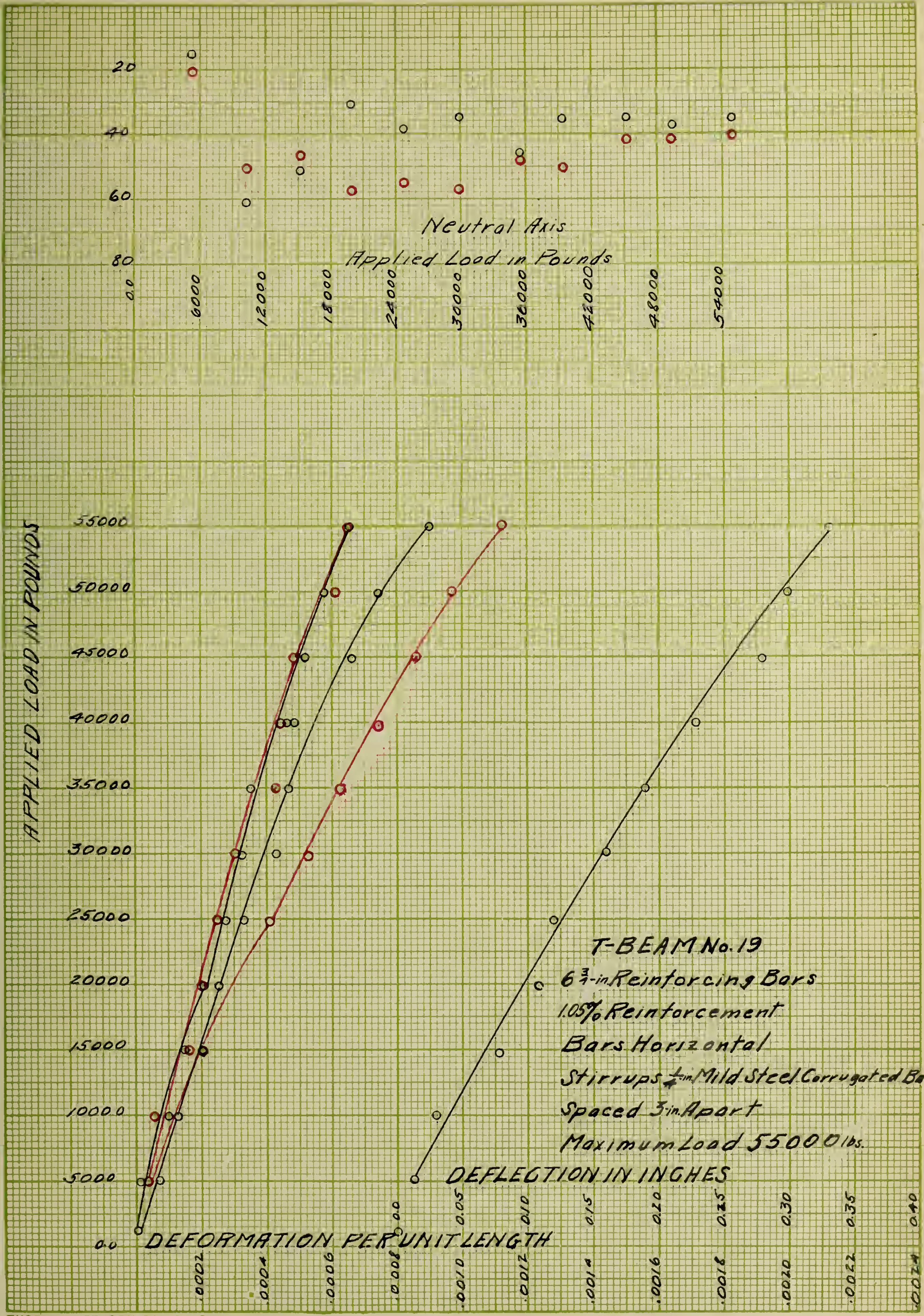

NEUTRAL AXIS
APPLIED LOAD IN POUNDS
20
40
60
80
0.0
6000
12000
18000
24000
30000
36000
42000
48000
54000
60000
APPLIED LOAD IN POUNDS
60000
55000
50000
45000
40000
35000
30000
25000
20000
15000
10000
50000
0.0
DEFLECTION IN INCHES
0.05
0.10
0.15
0.20
0.25
0.30
0.35
0.40
0.45
0.50
DEFORMATION PER UNIT LENGTH
.0002
.0004
.0006
.0008
.0010
.0012
.0014
.0016
.0018
.0020
.0020
T-BEAM No.16
6 3/4-in. Reinforcing Bars
1.05% Reinforcement
Bars Horizontal
Stirrups 5/8 in Mild Steel Round Rods
Spaced 6 in Apart
Maximum Load 56000 lbs.



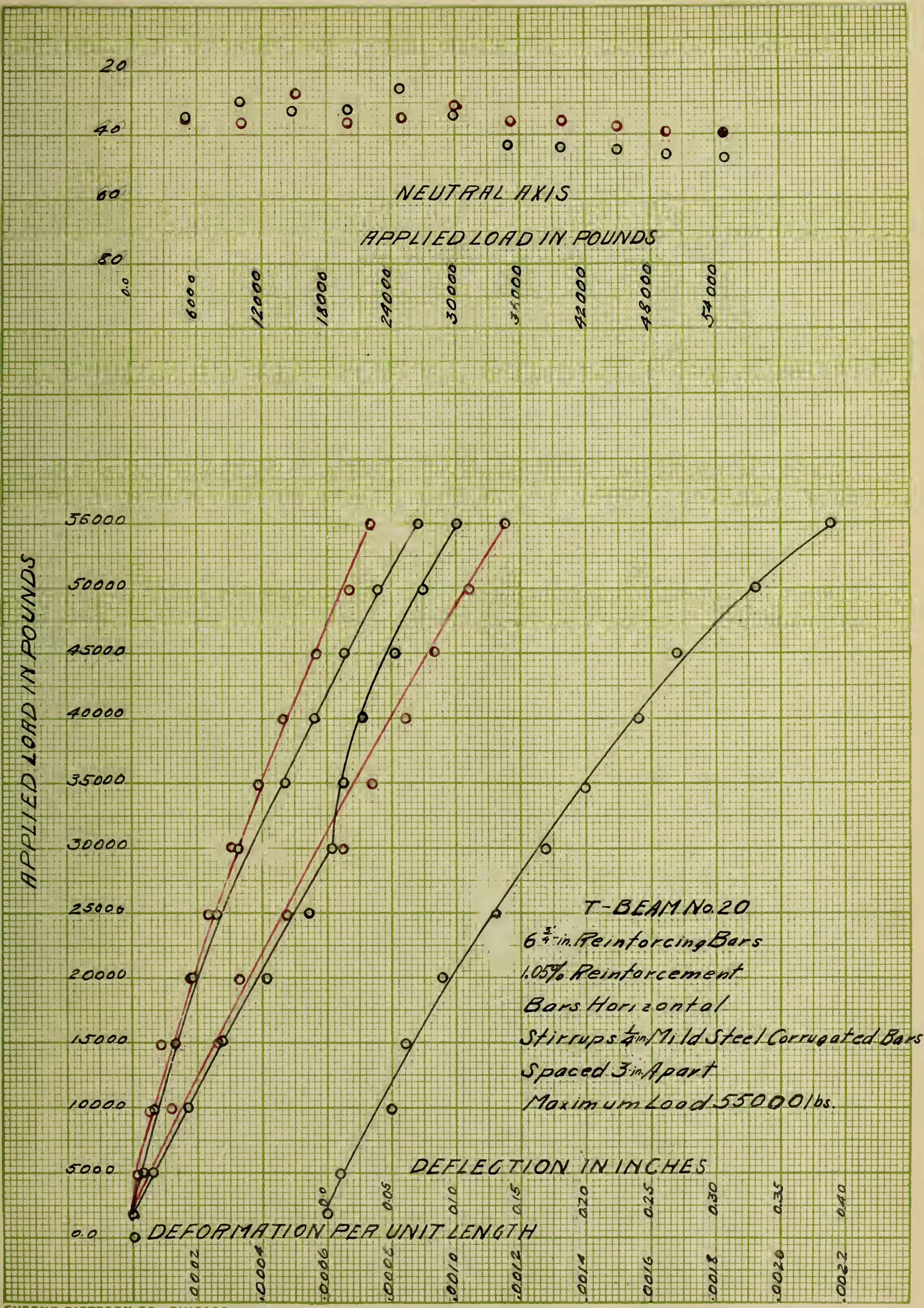
Neutral Axis
APPLIED LOAD IN POUNDS
20
40
60
80
0.0
6000
12000
18000
24000
30000
36000
42000
48000
54000
60000
66000
72000
APPLIED LOADS IN POUNDS
65000
60000
55000
50000
45000
40000
35000
30000
25000
20000
15000
10000
5000
0.0
Deformation per unit length
.0002
.0004
.0006
.0008
.0010
.0012
.0014
.0016
.0018
.0020
.0022
.0024
Deflection in inches
0.0
0.05
0.10
0.15
0.20
0.25
0.30
0.35
0.40
T-BEAM No. 17
6 3/4-in Reinforcing Bars
1.05% Reinforcement
Bars Horizontal
Stirrups 1/4-in High Steel Corrugated Bars
Spaced 3 in Apart
Maximum Load 66000 lbs.
EUGENE DIETZGEN CO., CHICAGO.

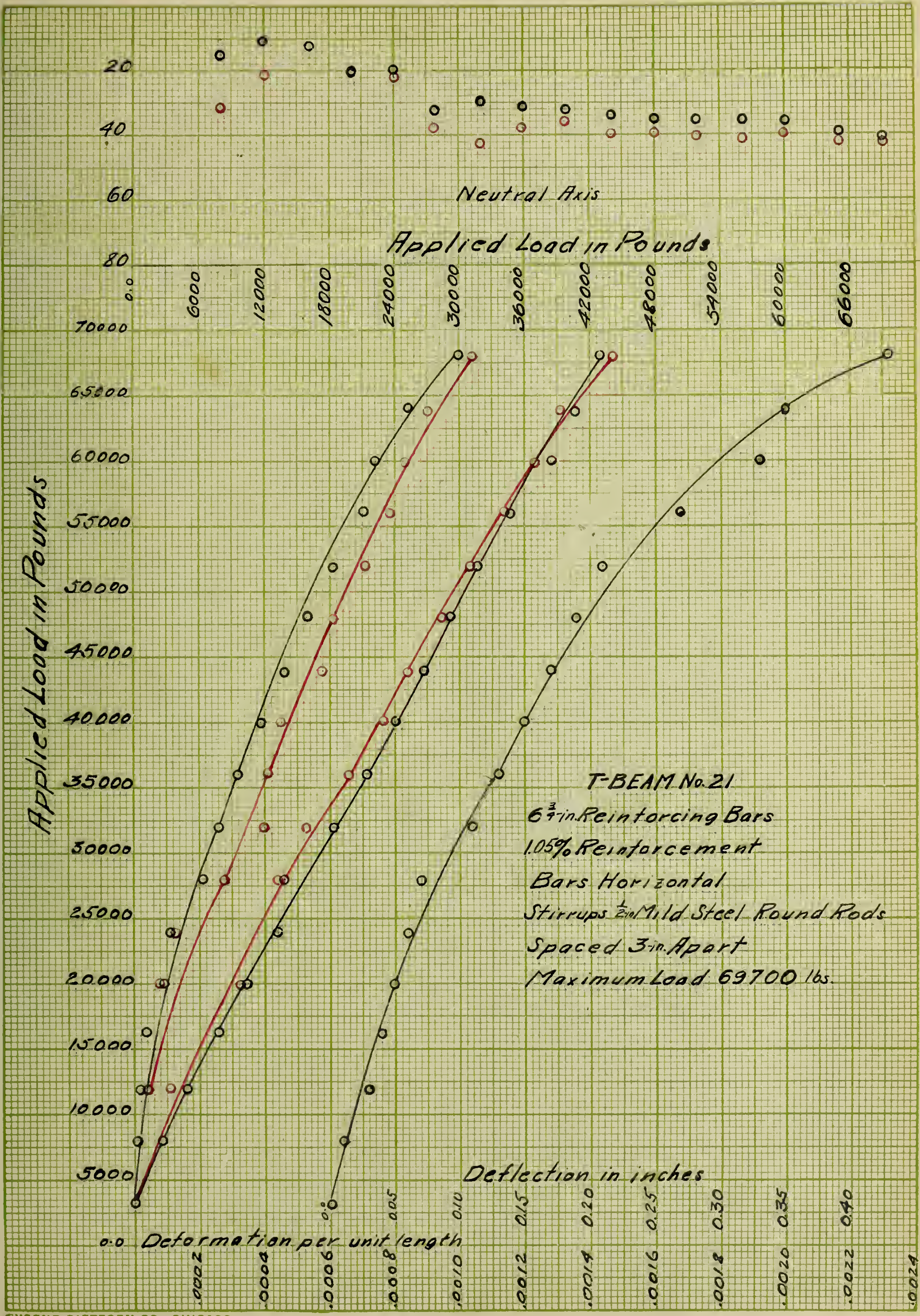


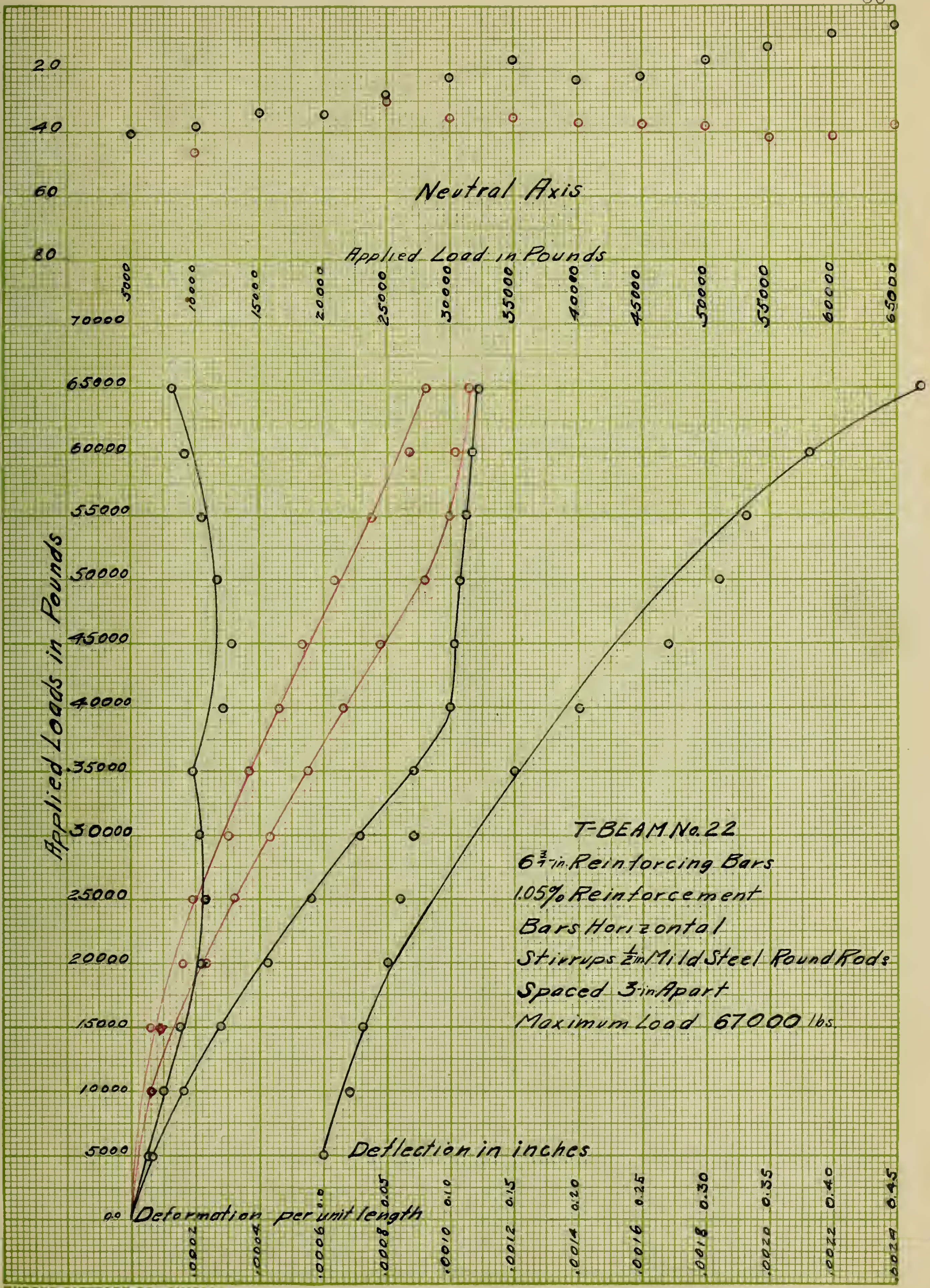
EUGENE DIETZGEN CO., CHICAGO.

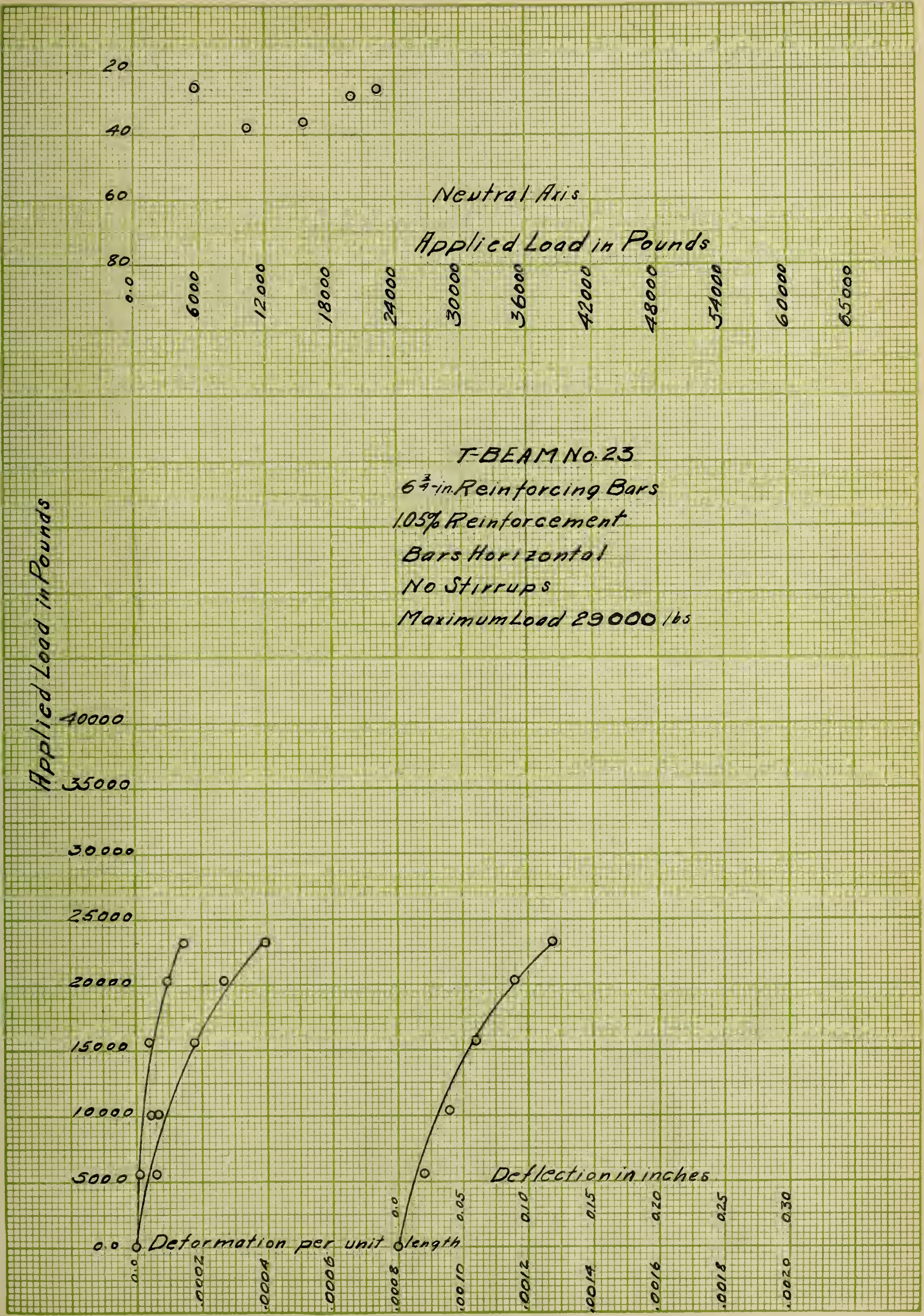


20
40
60
80
Neutral Axis
Applied Load in Pounds
0.0
6000
12000
18000
24000
30000
36000
42000
48000
54000
APPLIED LOAD IN POUNDS
55000
50000
45000
40000
35000
30000
25000
20000
15000
1000.0
5000
0.0
T-BEAM No. 19
6 ¾-in Reinforcing Bars
1.05% Reinforcement
Bars Horizontal
Stirrups ¼-in Mild Steel Corrugated Bars
Spaced 3-in Apart
Maximum Load 55000 lbs.
DEFLECTION IN INCHES
0.0
0.05
0.10
0.15
0.20
0.25
0.30
0.35
0.40
DEFORMATION PER UNIT LENGTH
.0002
.0004
.0006
0.008
.0010
.0012
.0014
.0016
.0018
.0020
.0022
.0024

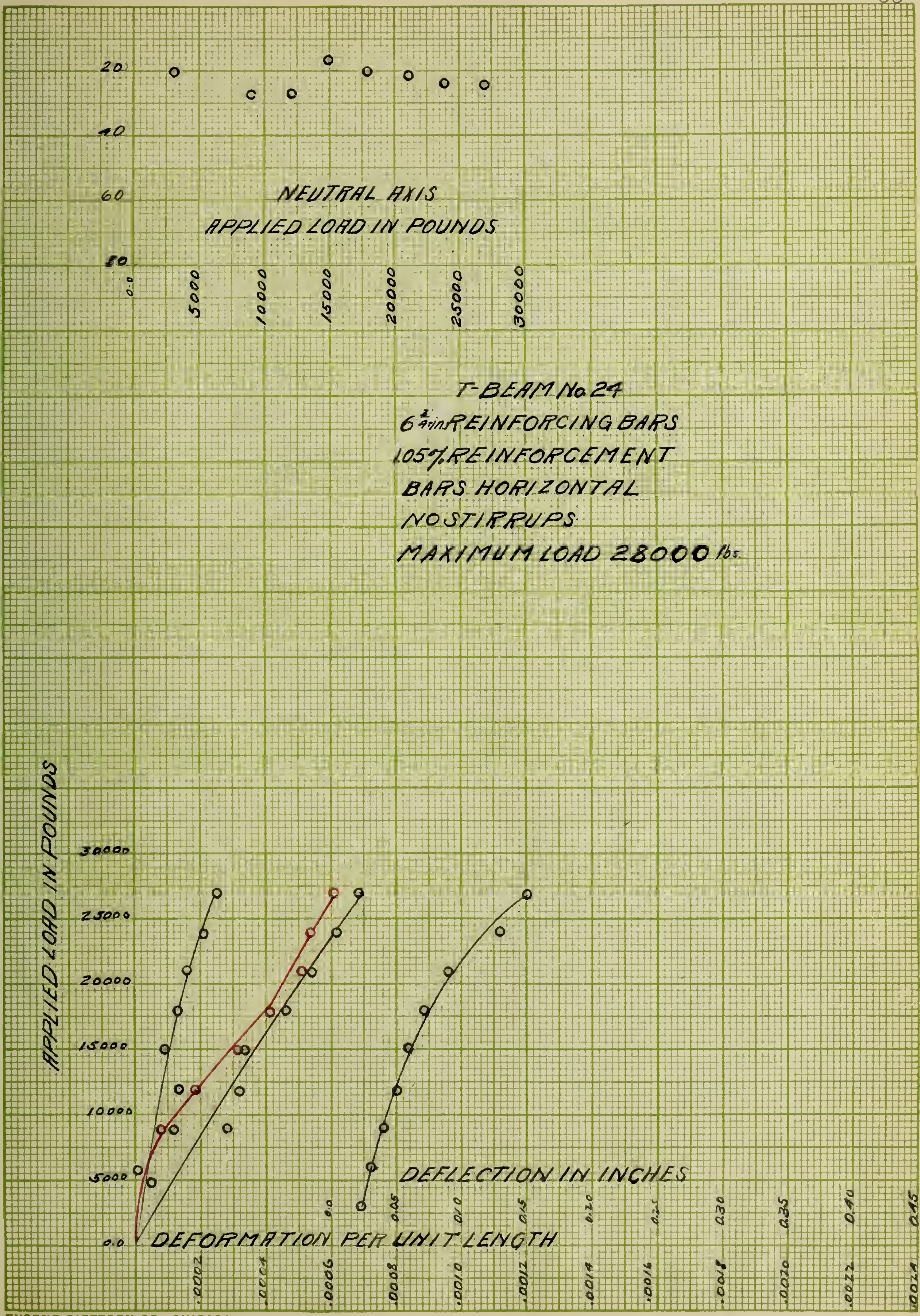

NEUTRAL AXIS
APPLIED LOAD IN POUNDS
20
40
60
80
0.0
6000
12000
18000
24000
30000
36000
42000
48000
54000
APPLIED LOAD IN POUNDS
55000
50000
45000
40000
35000
30000
25000
20000
15000
10000
5000
0.0
T-BEAM No.20
6 3/4 in. Reinforcing Bars
1.05% Reinforcement
Bars Horizontal
Stirrups 1/4 in. Mild Steel Corrugated Bars
Spaced 3 in. Apart
Maximum Load 55000 lbs.
DEFLECTION IN INCHES
0.0
0.05
0.10
0.15
0.20
0.25
0.30
0.35
0.40
DEFORMATION PER UNIT LENGTH
.0002
.0004
.0006
.0008
.0010
.0012
.0014
.0016
.0018
.0020
.0022


Neutral Axis
Applied Load in Pounds
Applied Load in Pounds
Deflection in inches
Deformation per unit length
T-BEAM No. 21
6 ¾-in. Reinforcing Bars
1.05% Reinforcement
Bars Horizontal
Stirrups ½-in. Mild Steel Round Rods
Spaced 3-in. Apart
Maximum Load 69700 lbs.

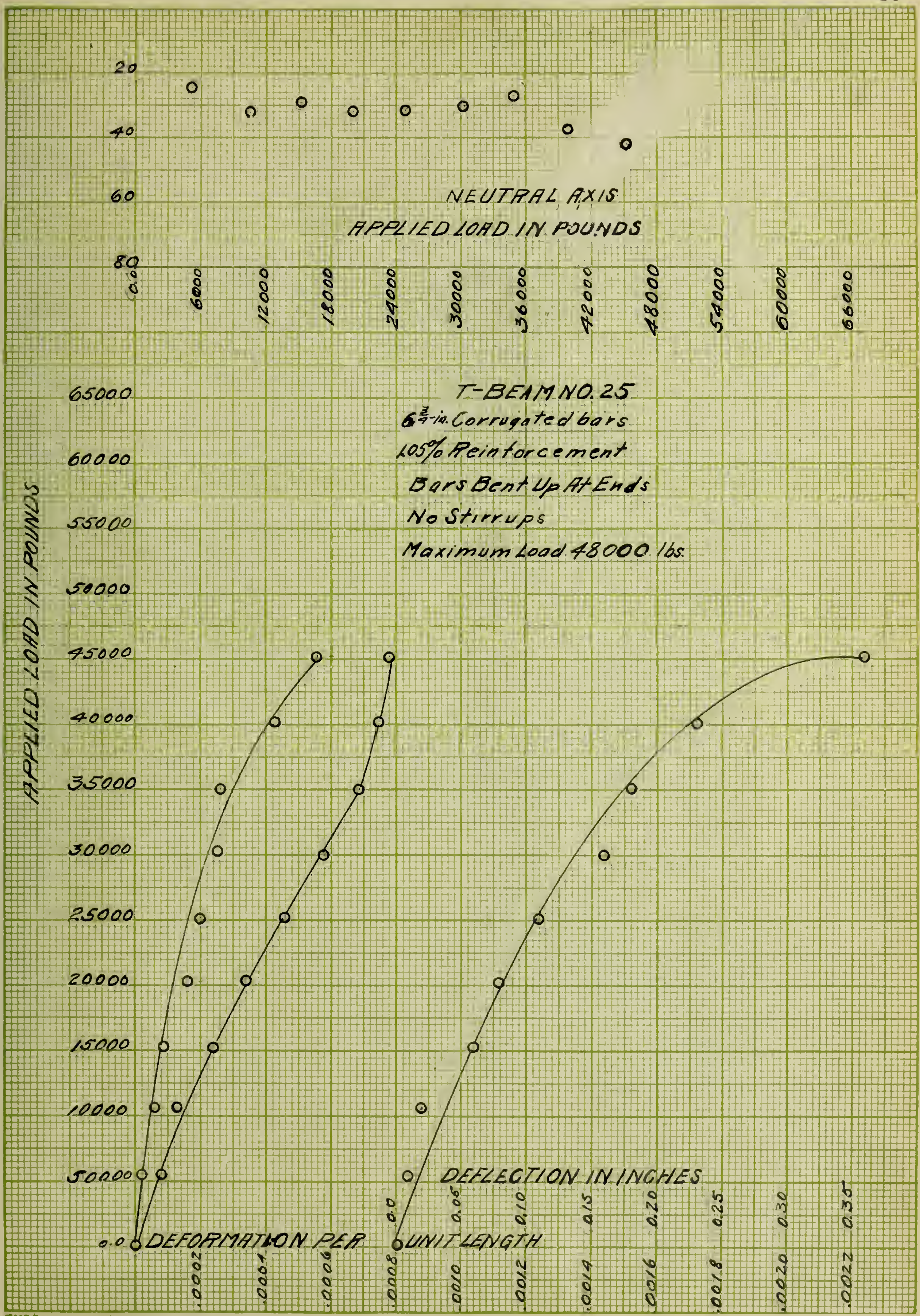

Neutral Axis
Applied Load in Pounds
Applied Loads in Pounds
Deflection in inches
Deformation per unit length
T-BEAM No. 22
6 3/4-in. Reinforcing Bars
1.05% Reinforcement
Bars Horizontal
Stirrups 1/2-in. Mild Steel Round Rods
Spaced 3-in. Apart
Maximum Load 67000 lbs.

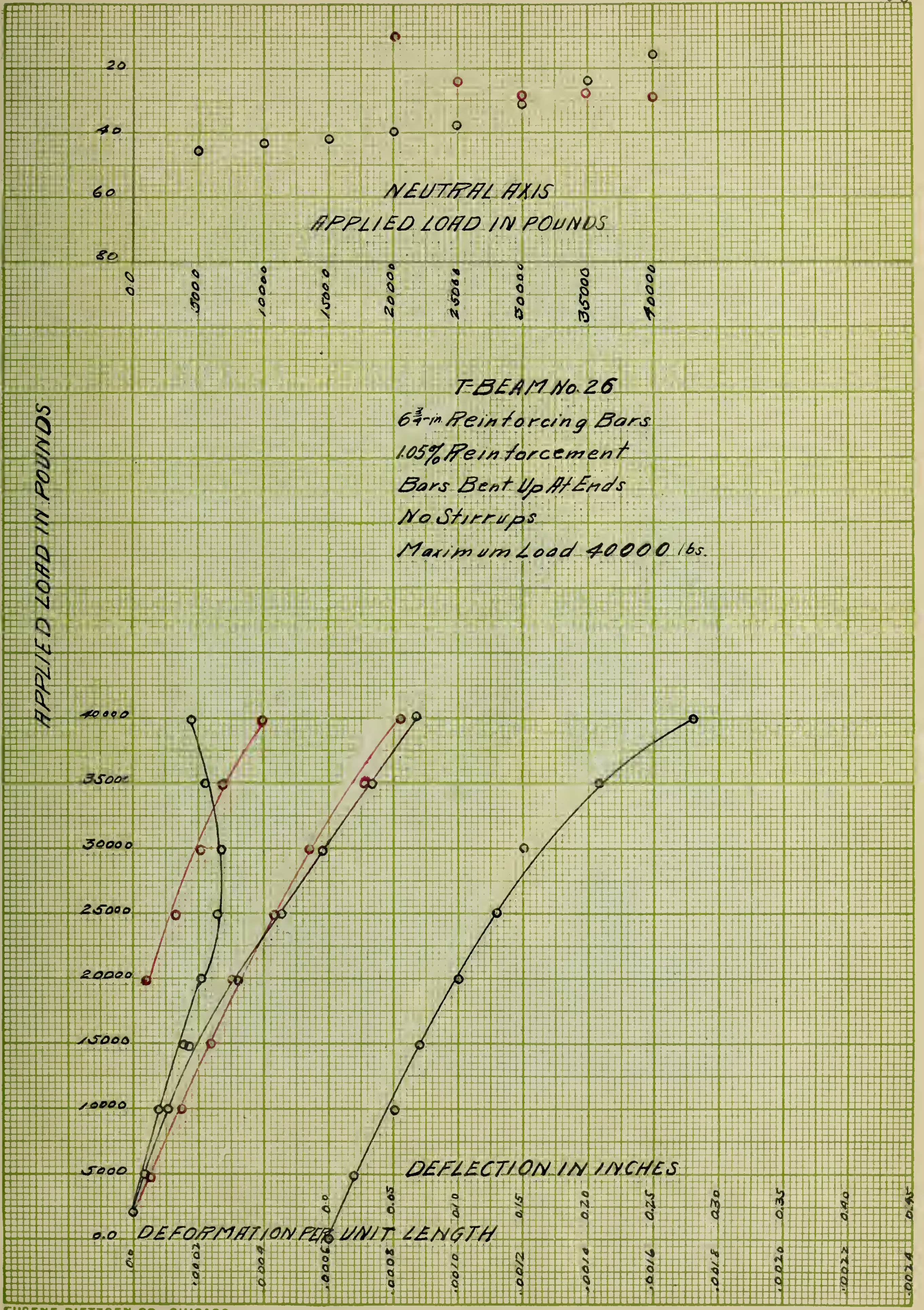


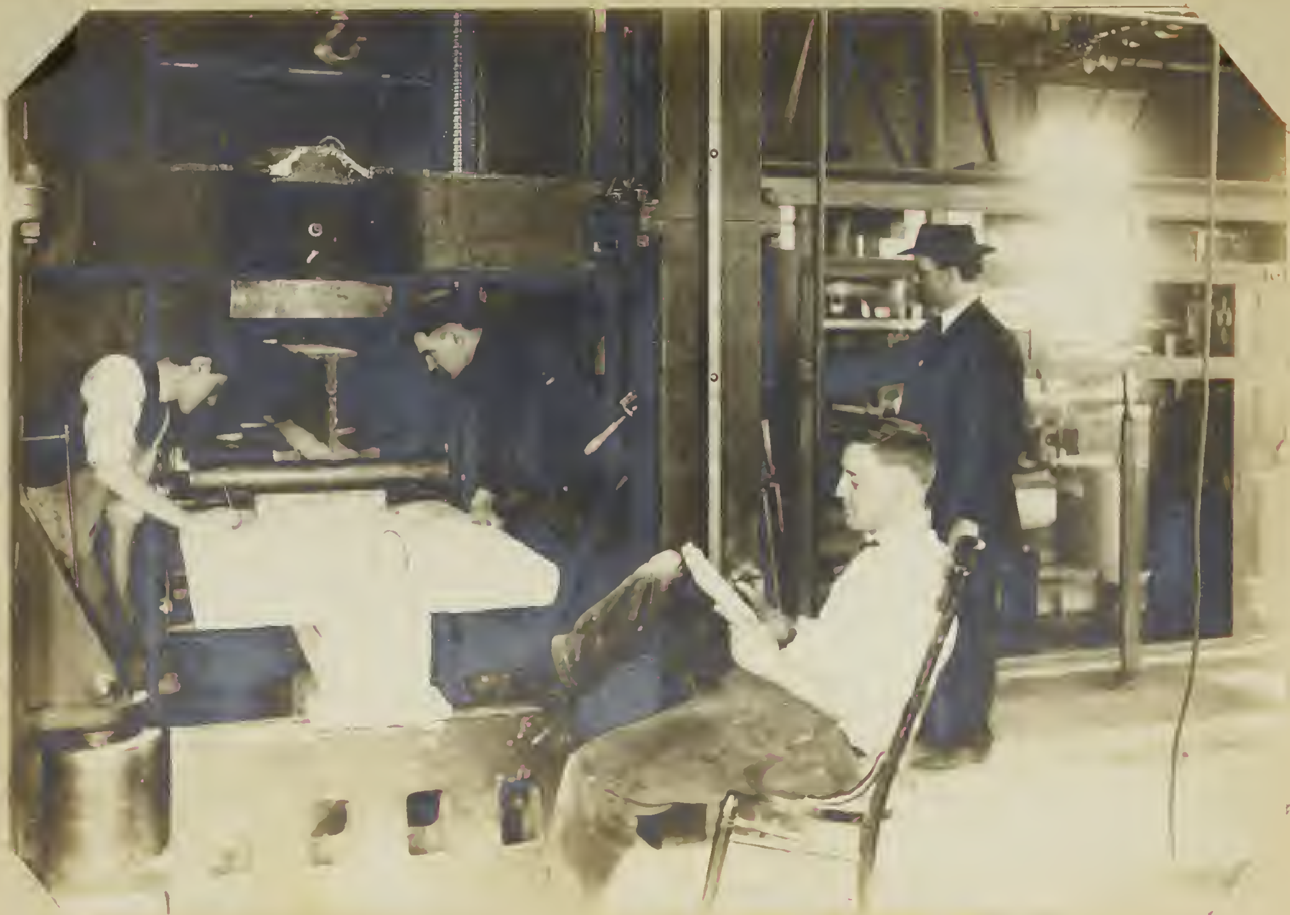
20
40
60
80
Neutral Axis
Applied Load in Pounds
0.0
6000
12000
18000
24000
30000
36000
42000
48000
54000
60000
65000
T-BEAM No. 23
6 ¾-in. Reinforcing Bars
1.05% Reinforcement
Bars Horizontal
No Stirrups
Maximum Load 29000 lbs
Applied Load in Pounds
40000
35000
30000
25000
20000
15000
10000
5000
0.0
Deformation per unit length
Deflection in inches
0.0
0.05
0.10
0.15
0.20
0.25
0.30
0.0
.0002
.0004
.0006
.0008
.0010
.0012
.0014
.0016
.0018
.0020



EUGENE DIETZGEN CO., CHICAGO.


NEUTRAL AXIS
APPLIED LOAD IN POUNDS
20
40
60
80
0.00
6000
12000
18000
24000
30000
36000
42000
48000
54000
60000
66000
T-BEAM NO. 25
6 ¾-in. Corrugated bars
1.05% Reinforcement
Bars Bent Up At Ends
No Stirrups
Maximum Load 48000 lbs.
APPLIED LOAD IN POUNDS
65000
60000
55000
50000
45000
40000
35000
30000
25000
20000
15000
10000
5000
0.0
DEFLECTION IN INCHES
0.0
0.05
0.10
0.15
0.20
0.25
0.30
0.35
DEFORMATION PER UNIT LENGTH
.0002
.0004
.0006
.0008
.0010
.0012
.0014
.0016
.0018
.0020
.0022


NEUTRAL AXIS
APPLIED LOAD IN POUNDS
20
40
60
80
0.0
5000
10000
15000
20000
25000
30000
35000
40000
T-BEAM No. 26
6 3/4-in. Reinforcing Bars
1.05% Reinforcement
Bars Bent Up At Ends
No Stirrups
Maximum Load 40000 lbs.
APPLIED LOAD IN POUNDS
DEFLECTION IN INCHES
DEFORMATION PER UNIT LENGTH
0.0
0.05
0.10
0.15
0.20
0.25
0.30
0.35
0.40
0.45
.0002
.0004
.0006
.0008
.0010
.0012
.0014
.0016
.0018
.0020
.0022
.0024



View of Testing in Progress

T-Beam No. 17 After Failure

T-Beam No. 21 Showing Flange Broken off

T-Beam No. 22 Showing
Flange Broken off.

T-Beam No. 23 Showing Failure by Diagonal Tension.