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A COMPARISON OF THE STRENGTH
OF CONCRETE RELATIVE TO THE
AMOUNT OF TAMPING IT RECEIVES

Thesis for the Degree of B. S.

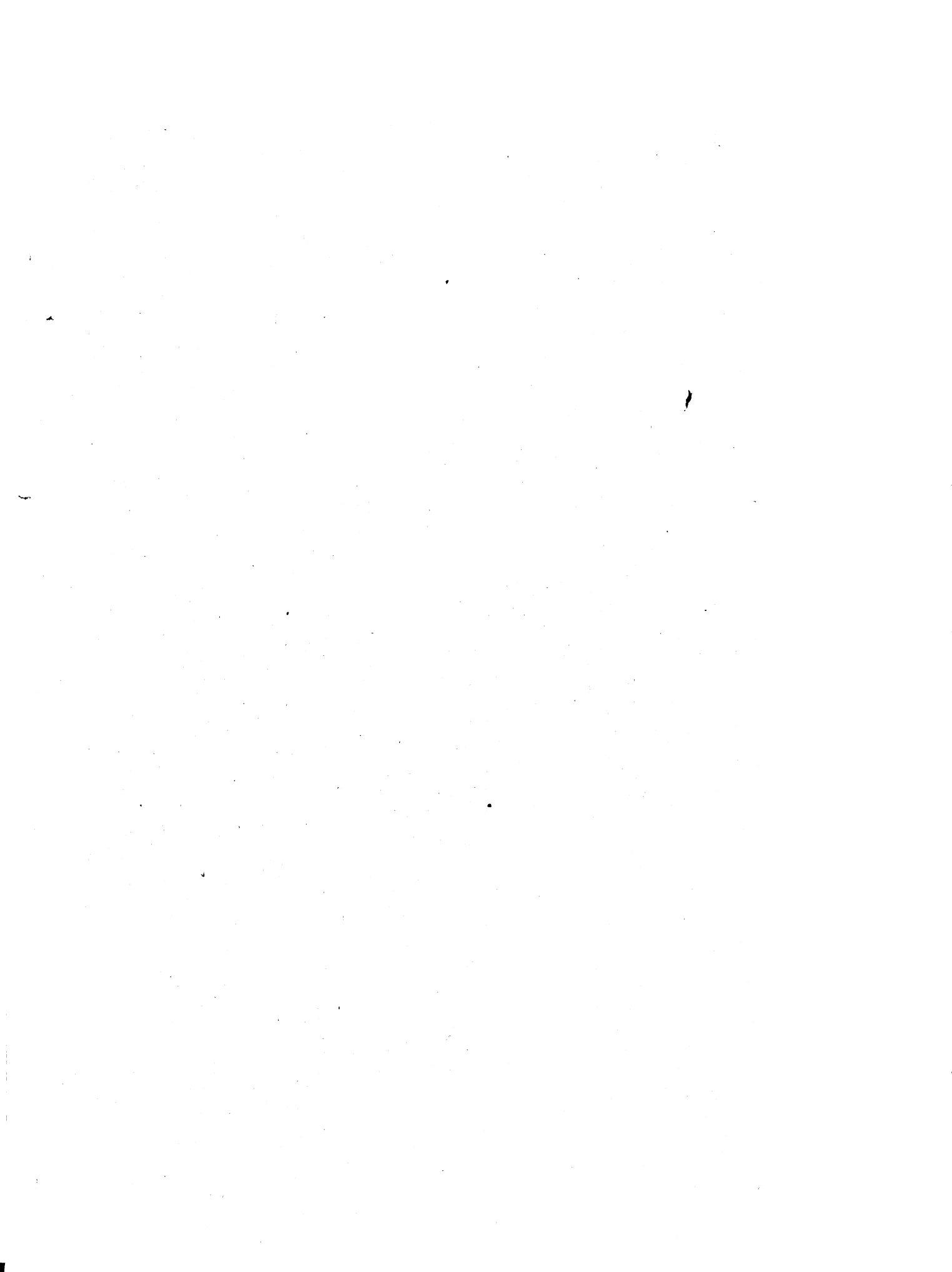
G. R. Smith

1927

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**A COMPARISON OF THE STRENGTH OF CONCRETE RELATIVE TO
THE AMOUNT OF TAMPING IT RECEIVES**

A Thesis Submitted to

The Faculty of

THE MICHIGAN STATE COLLEGE

of

AGRICULTURE AND APPLIED SCIENCE

By

G. R. Smith

Candidate for the Degree

of

Bachelor of Science

June 1927.

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Introduction

The present need for intense study of concrete mixtures becomes more and more evident as each day passes by. Concrete is being used in ever increasing quantities in fields in which its use is common and in addition many new uses are being found for it every day. In many cases concrete fails to come up to the requirements which are expected of it. This is, I believe, as much due to faulty methods of handling concrete mixture as to the incapability of the concrete itself to do what is required. Many construction firms pay little attention to the way in which they treat their concrete, especially after it is once in place.

The strength of concrete, which is the determining factor of its usefulness, varies a great deal according to the amount of attention and care which it receives after it has left the mixer and been poured into the forms. Very frequently the job of tamping is turned over to unskilled labor with no interest in the job and is consequently slighted. Tamping, in cases like this, becomes a mere matter of form and does no actual good. Occasionally the other extreme is reached and the mixture is tamped too much.

By tamping I mean the packing of a fairly dry mixture of concrete by means of some instrument in order that the various units of the mixture may gain closer proximity to each other and thus give the cement a better chance to hold them together.

In this experiment I have endeavored to determine the exact effect of tamping on the strength of concrete and also to determine the amount of tamping which will give the best results under the given conditions. Because of the wide ranges of uses to which concrete is put the results of the following experiment are not at all conclusive but are merely an indication of the relative value of various amounts of tamping and a suggestion of the method which might be used to determine the proper amount of tamping for any given concrete job.

The Experiment

This test consisted of breaking a number of concrete cylinders which I had previously made. The cylinders were equal in size, made of the same mixture of concrete, but were tamped a varying number of times and allowed to stand a varying number of days before breaking. By using the same mixture but varying the amount of tamping and the number of days the cylinders were allowed to stand before breaking I was able to determine the facts which I wanted to know, that is, the relative effect of different amounts of tamping upon the strength of a constant mixture at different ages.

First I made a complete test of my aggregates which consisted of the sieve analysis, cleanness and quality, and the test for moisture content. From the sieve analysis test I found the fineness modulus of the sand to be 2.23, and of the coarse aggregate to be 6.65. The aggregates were fairly clean and of a good quality. I found that a cubic foot of the sand dry rodded weighed 108.93 $\frac{1}{2}$ and that a cubic foot of the coarse aggregate dry rodded weighed 114.91 $\frac{1}{2}$. From the data thus obtained I designed my mix to give a slump of 2 inches.

When I came to make my mixture I found that it took 155.8 pounds of fine aggregate, 208 pounds of coarse aggregate, 31.23 pounds of water and 41.74 pounds of cement to make a total of three cubic feet of mixed concrete. This was the amount which I figured would fill the requirements for the cylinders which I had in mind.

Next I made the cylinders with the aid of another student. We used a round form that was 6 inches high and 3 inches in diameter. We made a total of 96 cylinders which I divided into eight sets, each set consisting of twelve cylinders. My idea was to vary the amount of tamping among the different sets and to break four cylinders of each set at 7, 14, and 28 days. By using this method I could determine the effects of the different amounts of tamping on the cylinders at different ages and thus gain data on which to base my conclusions.

After making the forms for the cylinders and the mixture we poured them using the following method: we filled the first set of twelve forms approximately half full and then tamped the mixture ten times using an ordinary round laboratory rod $\frac{5}{8}$ in diameter. We then finished filling the forms for the first set, and after filling tamped each cylinder ten more times.

When we came to pour the next set we used the same method except that we tamped each cylinder 20 times when the form was half full and twenty times again when it was full. We repeated this process with all of the sets, giving each successive set ten more tamps per cylinder when the form was half full and ten more when it was full. Thus we tamped the last set seventy times when it was half full and seventy when the forms were full. One set was poured without any tamping at all. This used up all of the eight sets of twelve which had been made.

After pouring and tamping the cylinders I let them all stand for 24 hours when I placed them in the moist chamber. I left each cylinder in the moist chamber after they were placed there until the time for breaking came.

After the cylinders had been poured for seven days I took four from each set out of the moist chamber and prepared them for breaking by capping each one on each end with plaster of Paris. After this had been done they were ready for the test which consisted of placing them in a large testing machine and applying gradually increasing pressure until the cylinder failed and broke.

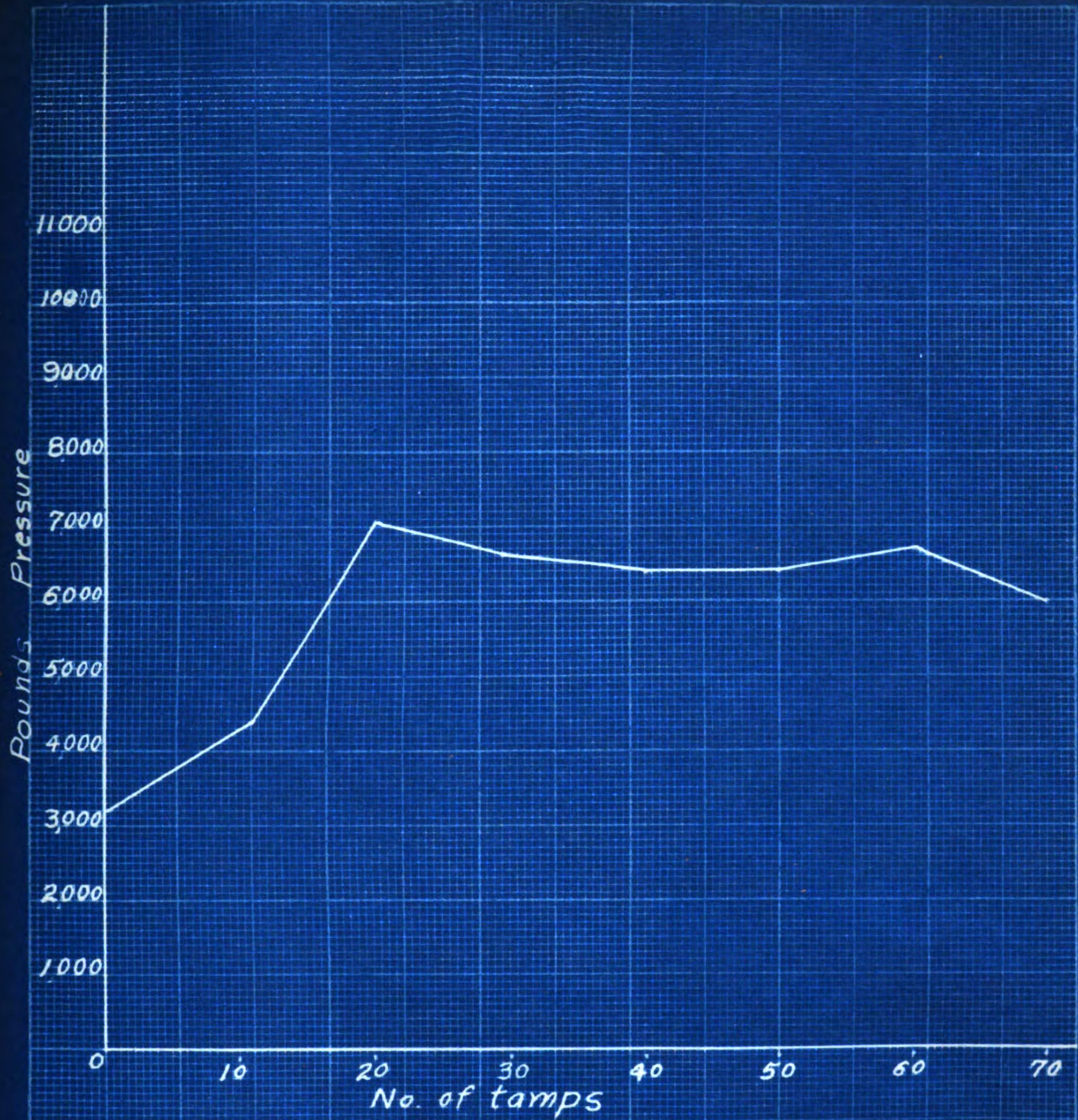
The scale readings at the points where the various cylinders broke were carefully noted and were used as a basis upon which I made graphs of the results.

These graphs were made by taking the average breaking point of the four cylinders of each group which were broke at each time and using this average breaking point for each four as the breaking point for cylinders which had received the particular number of tamps which that particular set had received. By using four cylinders instead of one I tried to more nearly determine the true value of the tamping process in its various degrees of thoroughness.

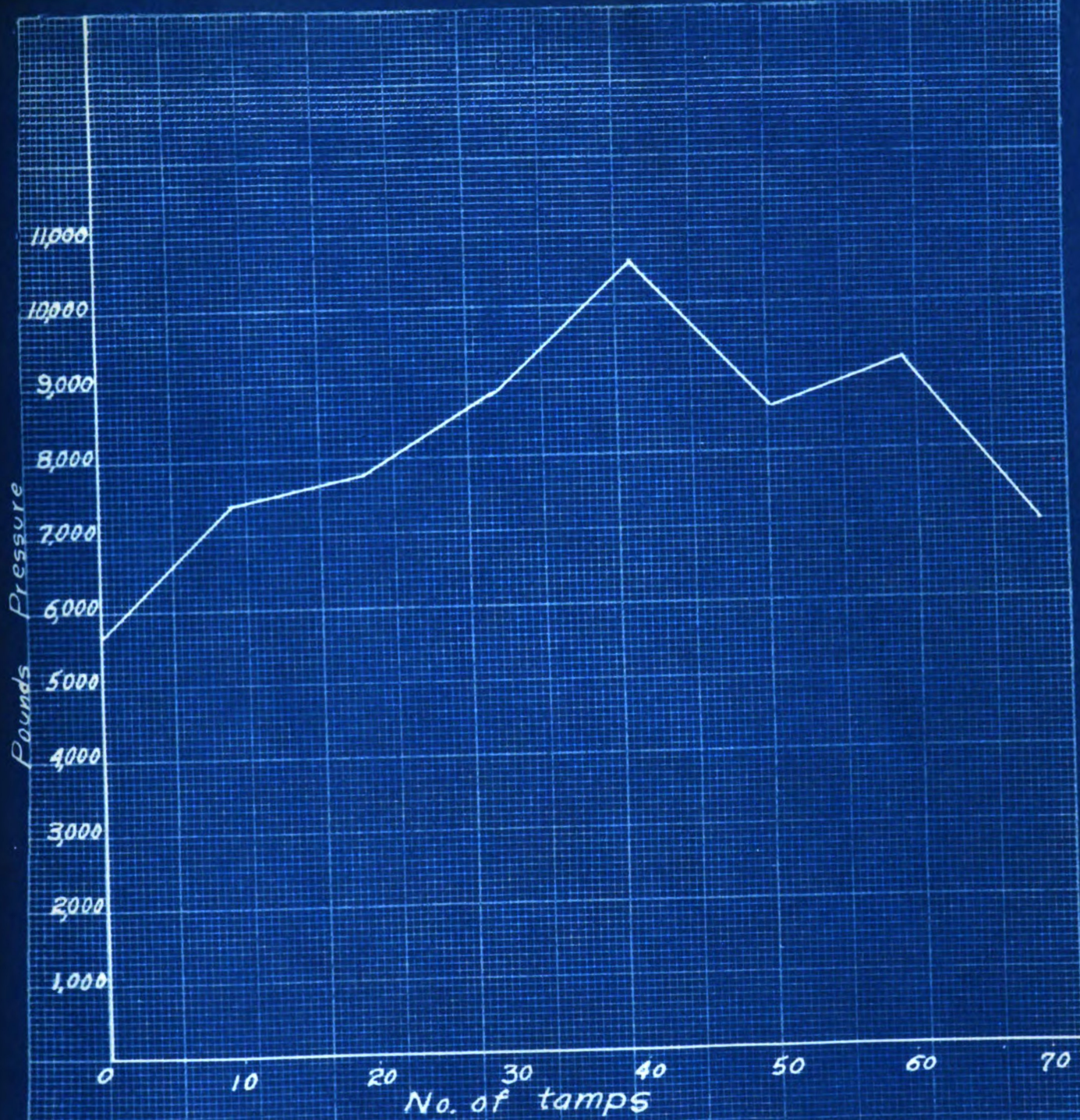
The results of the breaking test showed that the effectiveness of the various number of tamps varied relatively with the amount of time which the cylinders were allowed to stand before breaking, but that generally speaking the most effective number for the particular conditions under which I was working lay somewhere between 35 and 45.

On the following sheets are shown the graphs which are an accurate tabulation and portrayal of the results of this experiment.

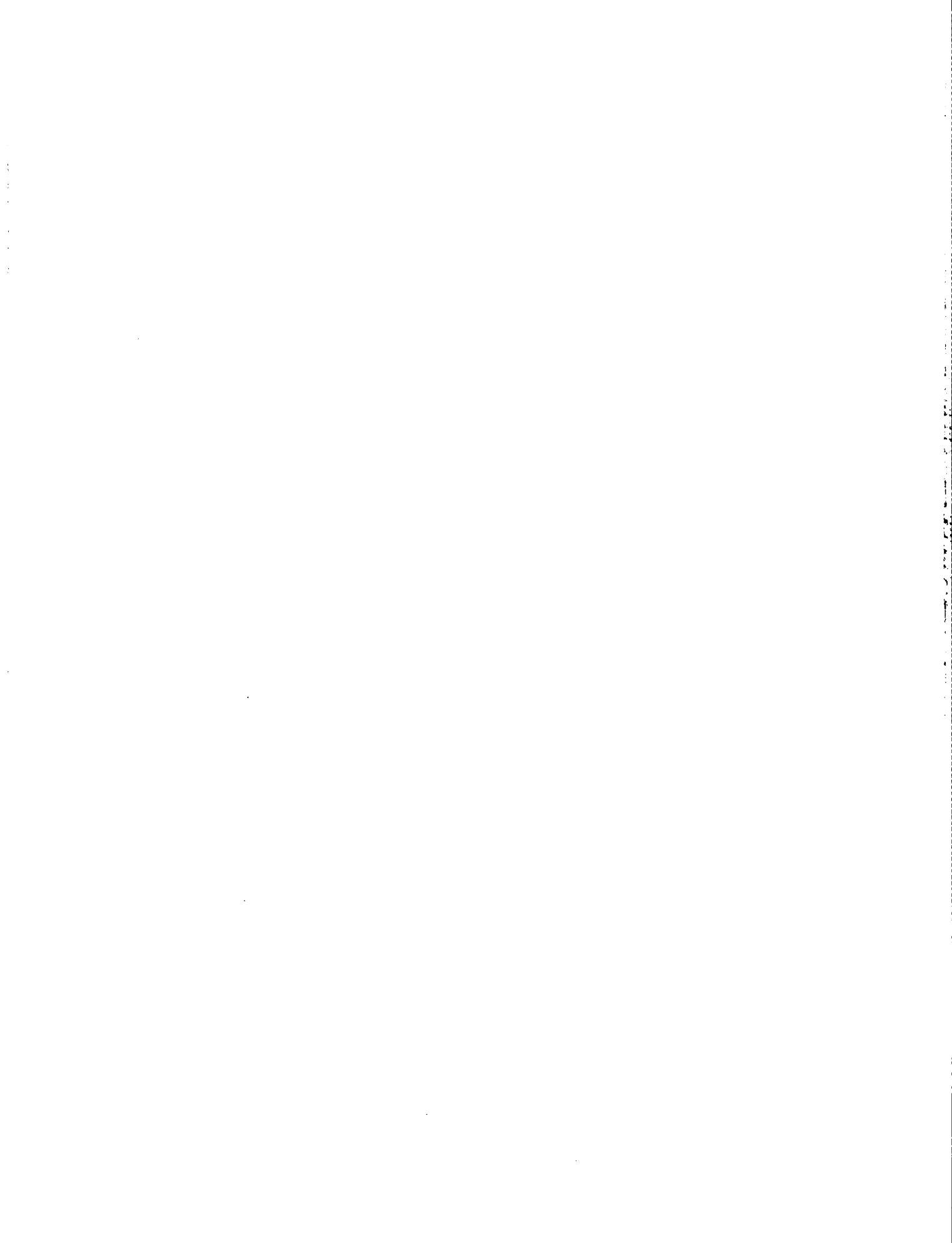


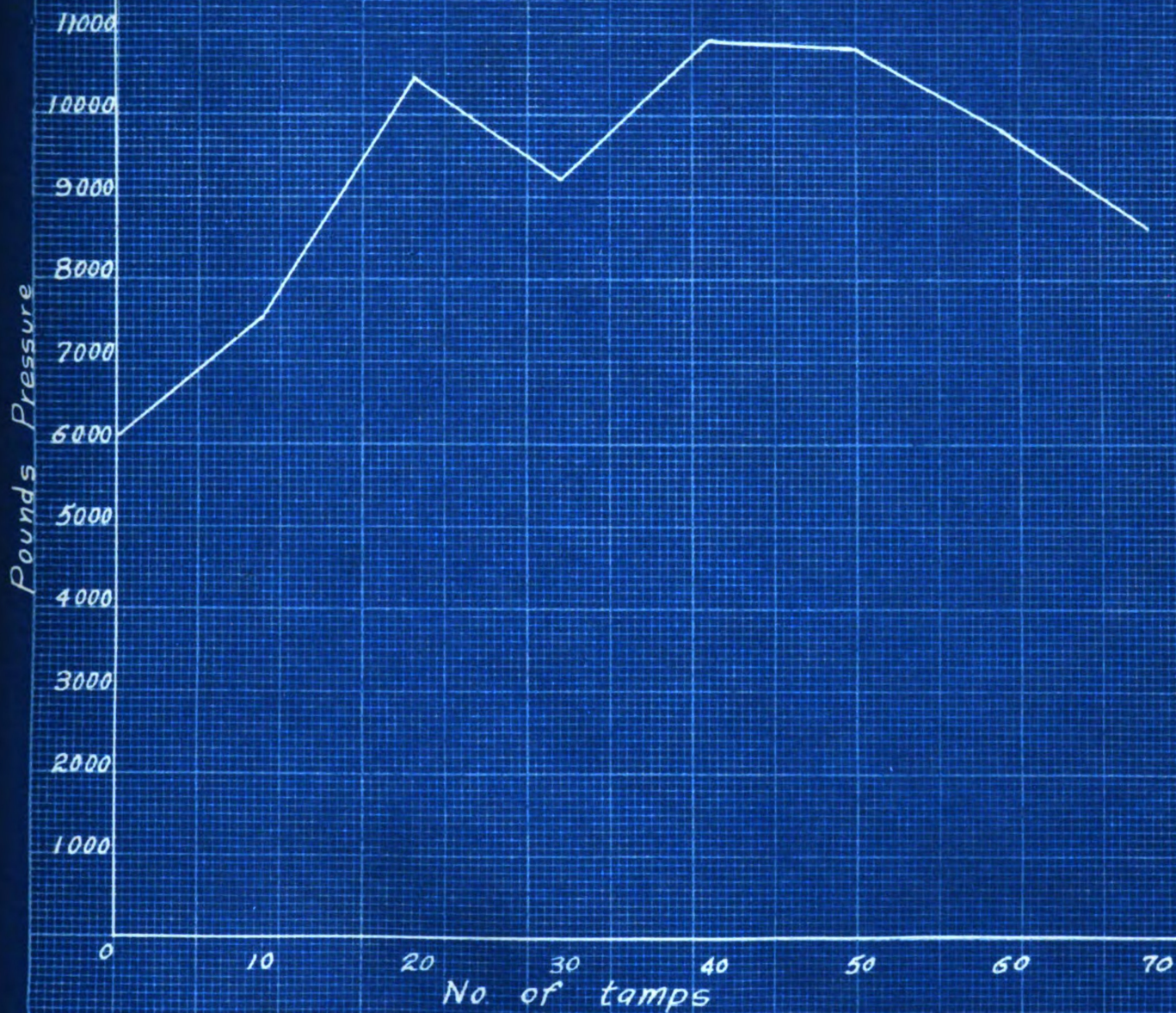


Results of Cylinders
At End of Seven Days



Results of Cylinders
At End of Fourteen Days





Results of Cylinders
At End of Twenty-eight Days

Conclusion

In this thesis I have attempted to determine whether the amount of tamping given concrete affects its strength. I realize that if I had made a larger number of cylinders and had varied the tamping over a greater field that my results would have been more reliable. However this was impossible and the value of this thesis lies in the fact that it furnishes an indication that there is some relation between the amount of tamping which any given concrete mixture receives and its final strength and also suggests a means which may be used to determine the amount of tamping for any given mixture on any specific job.

Another thing which must be taken into account is the fact that it would be very hard to approximate job conditions in a laboratory. Any findings or results are therefore only general and must be taken as such.

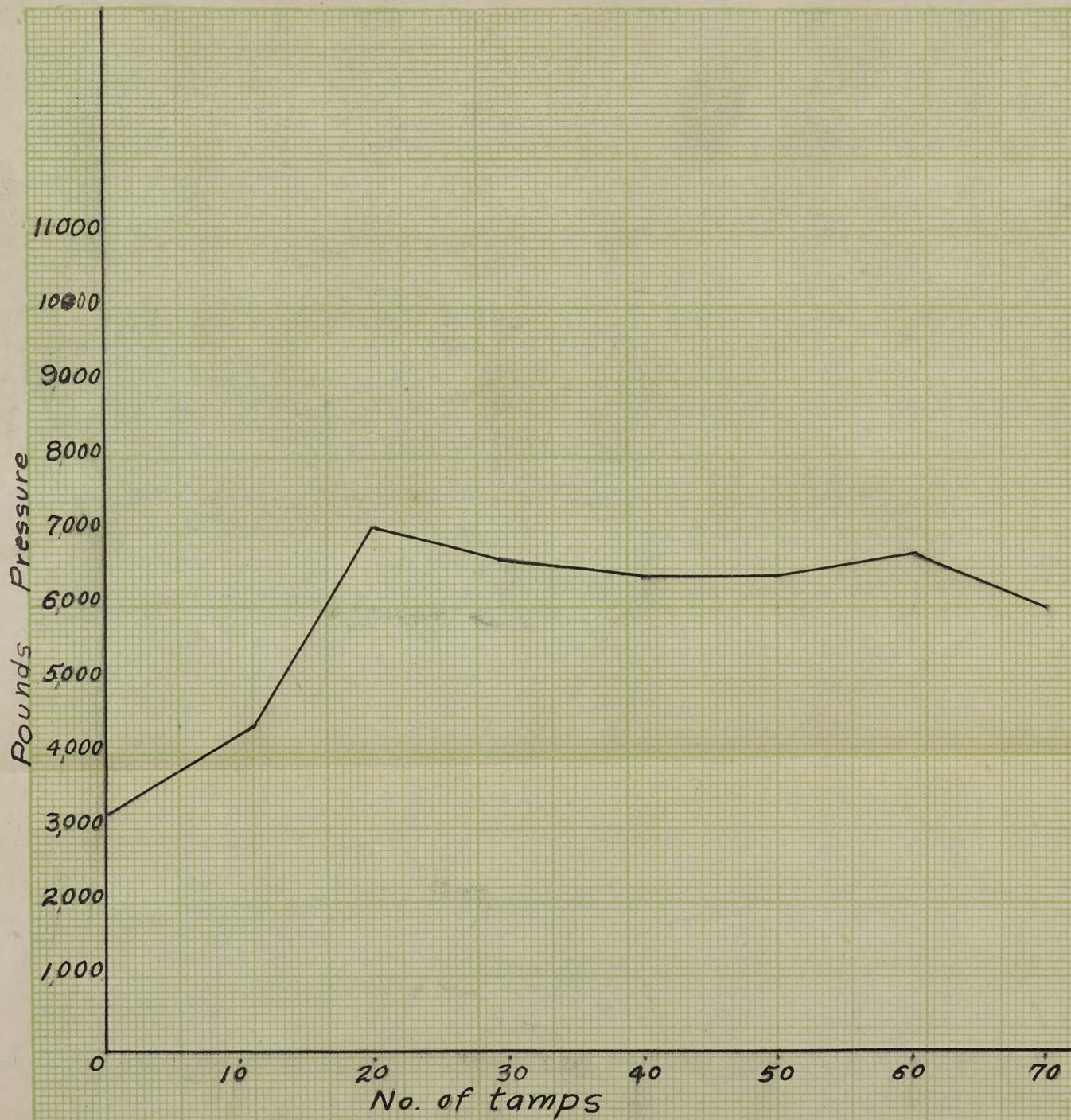
The previous graphs show that under the conditions in which this particular experiment was worked that tamping does have a decided effect upon the strength of concrete. They further show that untamped concrete is comparatively weak and that increasing amounts of tamping increase the strength up to a certain point, which in the case of this experiment was between 35 and 45 tamps when the forms were half full and the same number when they were full. After this maximum point the graphs show a decrease in strength. An important thing must be noted here. The drop in strength after a larger number of tamps were given the mixture is slight compared to the rapid increase in strength when the number of tamps was few and was being increased.

Therefore, while there is an ideal amount of tamping for each mixture and each type of work, there is more likelihood of falling under this amount of tamping than there is of going over it, and on any given concrete job care should be taken that the mixture is tamped enough because there is very little danger of overtamping.

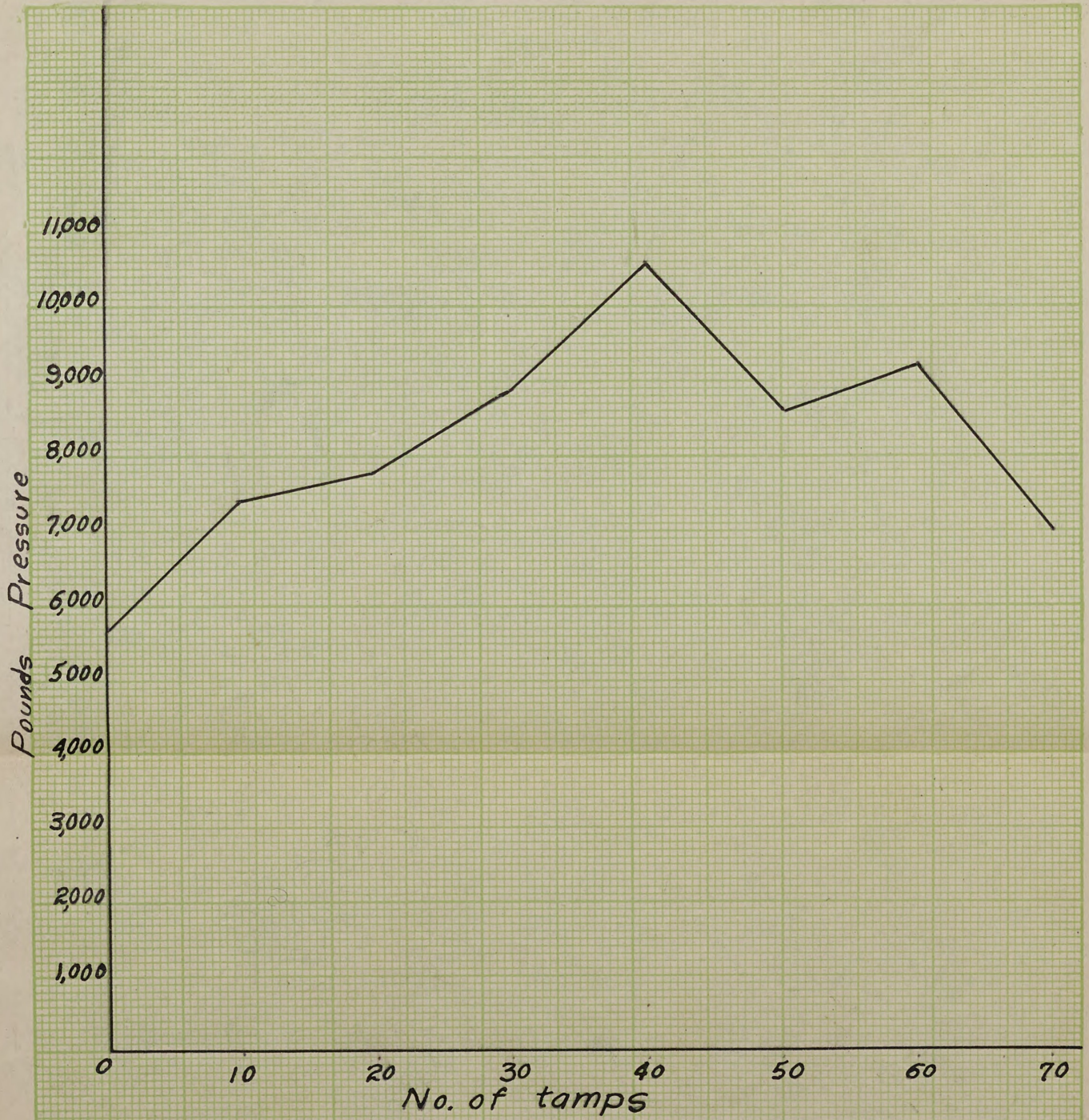
Respectfully submitted,

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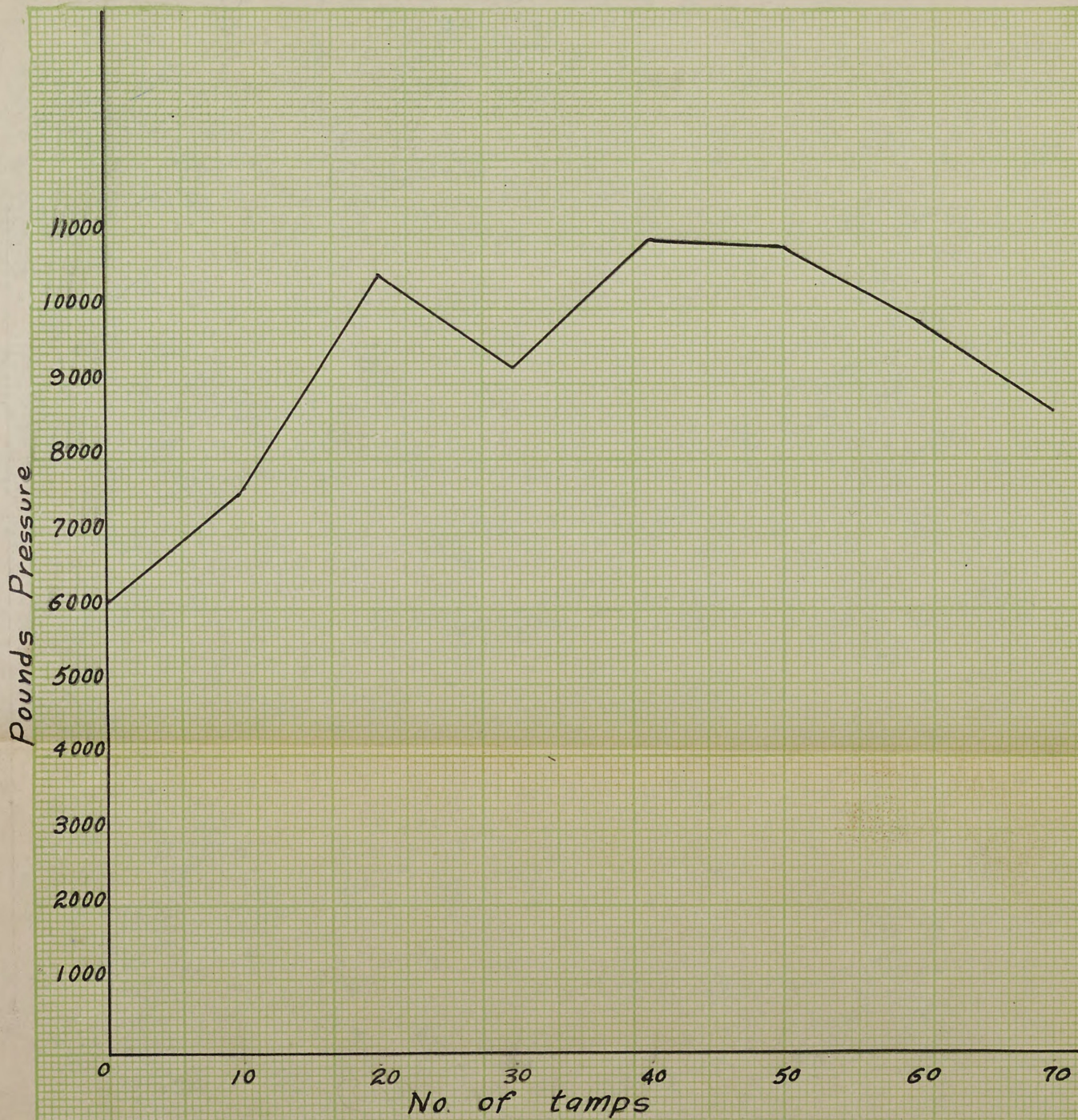
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Results Of Cylinders
At End Of Seven Days



Results of Cylinders
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Results of Cylinders
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