will remain in force for another four years, Nipigon power will be supplied in Fort William to the expiration of this agreement to individual customers. At the expiration of the Kaministiquia Power Co.'s agreement, however, the power now being supplied to the existing municipally-owned system of the city will be furnished by the Hydro system.

REPORT OF COMMITTEE ON FIREPROOFING OF THE AMERICAN CONCRETE INSTITUTE

SINCE the previous report of the Committee on Fireproofing of the American Concrete Institute a considerable number of fire tests of concrete columns have been made by the Bureau of Standards at Pittsburgh. The report communicating these test results has been made the basis of certain changes in the committee's recommendations. As will be seen from that report and the previous reports of the fire tests of concrete columns made at Pittsburgh, extensive spalling has invariably taken place in the fire tests of hooped columns from highly silicous gravels, made in the usual way. Most of the columns tested have had a thickness of 1½ in. of protective concrete over the steel. Two columns, Nos. 79 and 80, from Pittsburgh gravel with 2½ in. of protective concrete (see Table) gave results that were distinctly better than those with protective concrete only 1½ in. thick, Nos. 73, 74 and others, and yet so poor, in comparison to those shown by columns from more favorable aggregates, with 1½ in. of protective concrete, that the expedient of securing better protection in the case of columns from highly silicious gravel, by providing an unusual thickness of protective concrete, does not seem worthy of recommendation.

On the other hand, the two columns from Pittsburgh gravel, Nos. 77 and 78, with a thickness of 1½ in. of protective concrete, reinforced by a light grade of expanded metal, of large mesh, to prevent the loss of protective concrete by spalling, gave fairly satisfactory results. While the results of the test of these columns were not as good as those from columns from limestone, trap rock and blast furnace slag aggregates, the loss of strength in the four-hour fire test, as determined by loading to failure in the furnace while the column was still hot, was less than 60% in both cases, which presents a strong contrast to the results from columns from the same aggregate, Pittsburgh gravel, without reinforcement in the protective concrete, which failed under the working load before the four-hour fire test was completed.

Columns from Pittsburgh gravel, Nos. 82 and 83, with 2½ in. of protective concrete, with the light, expanded metal reinforcement in the outer concrete, to prevent the loss of protective concrete by spalling, could not be loaded to failure in the furnace, at the end of the four-hour fire test, due to the fact that their strength exceeded the load limit of the furnace equipment, which is equivalent to a stress of approximately 3,480 pounds per square inch on the effective area of these columns. When tested cold, after fire test, in a testing machine of high capacity, these columns showed an ultimate strength only slightly lower than that of a similar column, No. 84, which had not been subjected to fire test.

Value of Mesh Reinforcement

Judging from these results, it would appear that if the protective concrete of columns from highly silicious gravel aggregates were reinforced with expanded metal so as to prevent loss of protective concrete by spalling, they would be sufficiently protected by the thicknesses of protective concrete recommended for different conditions in the last report of this committee. The expedient of providing such reinforcement in the protective concrete of columns made from highly silicious gravels is accordingly included among the recommendations for columns.

Two gravel concrete columns, Nos. 85 and 86, in which the aggregate was low in quartz content, have been fire-tested. Approximately 90% of the gravel was made up of limestone pebbles, and there was a high percentage of limestone in the sand. The columns had 1½ in. of protective concrete with no expanded metal. These columns showed no tendency to spall in the fire test and gave comparatively good results in other respects. Neither of them failed under the maximum furnace load when tested hot at the end of the four-hour fire test. When tested cold, after the fire test, the ultimate strength was found, in both cases, to be more than 75% per cent. of that of a similar column, No. 87, which had not been submitted to fire test.

These results indicate that gravels and sands that are very high in limestone content are suitable for use in fire-resistive concrete. It is probable that all gravels that are low in quartz may prove, on investigation, to be free from the spalling tendency. How high a proportion of quartz can

DATA FROM TESTS OF ROUND HOOPED COLUMNS OF FIFTEEN INCH EFFECTIVE DIAMETER

Aggregate	Column No.	Thickness of protective concrete, in.	Time of failure under working load Hrs.	Time of failure under working load Mins.	Max. Stress tested cold without fire test lbs. per sq. inch	Max. Stress at end of 4 hr. fire test lbs. per sq. in.	Max. Stress tested cold having been loaded to 3480 lbs. per sq. in. at end of 4 hr. fire test
	73	1½	3	50	....	....	....
	74	1½	3	20	....	....	....
	75	1½	..	..	4,880	....	....
Pittsburgh gravel	*77	1½	..	..	....	1,995	....
Pittsburgh sand	*78	1½	..	..	....	2,120	....
	79	2½	..	..	....	1,495	....
	80	2½	..	..	....	1,640	....
	81	2½	..	..	5,590	....	....
	*82	2½	..	..	....	....	5,115
	*83	2½	..	..	....	....	4,950
	*84	2½	..	..	5,155	....	....
High limestone gravel....	85	1½	..	..	....	....	4,440
High limestone sand	86	1½	..	..	....	....	5,240
	87	1½	..	..	5,620	....	....

*Those columns which had expanded metal in the protective concrete are indicated by an asterisk.

be included in gravels without the resulting concretes spalling under fire test conditions cannot be determined from the tests thus far made. The evidence now available appears to be sufficient, however, to justify the recommendation, which is to be found in a later paragraph of this report, that gravels high in limestone content be given a preference, for fire-resistive concrete, over highly silicious gravels.

Amended Recommendations

The recommendations made in the report of this committee, for 1919, amended to conform to the evidence presented in the foregoing discussion, may be stated as follows:—

1. That in concrete columns where four-hour protection is required, protective material not less than 2 in. in thickness shall be provided over the steel. In columns in which a high percentage of steel is used, increasing the importance of affording it ample protection, the thickness of protective material shall be 2½ in. for four-hour protection, and special care shall be given to the accurate placing of the steel in the forms, to avoid inadequate protection on any side.

2. That for fire-resistive construction, limestone, trap rock, blast furnace slag, well-burned clay and gravels, composed largely of limestone pebbles, be given a preference over highly silicious gravels.

3. That where highly silicious gravel aggregate is to be used, in columns without hooping, and with no special safe-