ACPC Technical Note No. 26

CONDUCTOR GALLOPING FIELD OBSERVATION ANALYSIS UPDATE

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I. INTRODUCTION

In 1981,the Laboratory presented in an IEEE paper (1) the results of a lengthy analysis of its collection of field observations of galloping behavior of single conductor lines. The collection had been drawn from several sources, most notably the EEI Galloping Conductor Task Force, the Utilities Research Commission, Ontario Hydro and EPRI. It comprised 122 observation reports of galloping of single conductor spans or lines. One of the significant results of the analysis that was included in the paper was a suggested guide to maximum expected vertical galloping amplitudes.

It had been planned to continue the collection and analysis of field observation reports in an organized manner with the support of outside funding. Unfortunately, this did not carry through. However, some additional observation data have been received and processed. The purpose of this Note is to draw attention to the effect of these additional observations upon the guide to maximum expected amplitudes.

II. SOURCES OF DATA

The previous collection of cases was comprised of sets of reports from different sources as listed in the following table.

TABLE I

Numbers of Reports from Various Sources - 1981

Source		No. of Reports
EEI Galloping Conductor Task Force		76
Utilities Research Commission		9
Ontario Hydro		18
EPRI RP 1095		8
Other		11
	Total	122

The reports that have been added to the single conductor analysis also came from several sources. Ontario Hydro contributed five cases. Eleven new cases came from EPRI's RP 1095. The Commonwealth Edison Co. provided six. In addition, a summary of fifteen reports of outages caused by galloping was provided by CORECH, a European-based cooperative research group. Although that summary was not based upon direct observation of galloping behavior, the occurrence of outages made possible very reliable minimum estimates of the amplitudes that must have occurred, since phase-to-phase clearances were documented. Thus the total number of cases in the single conductor collection was brought to 159.

III. METHOD OF PRESENTATION

In the 1981 IEEE paper, the results were presented in the form of a graphical function which was offered as a guide to maximum expected vertical amplitudes of galloping. The function gave the ratio of peak-to-peak amplitude, Ymax, to span length, S, as a function of parameters M' and T/w. M' is a catenarity parameter that is calculated from various characteristics of a span's design. T/w is tension to weight ratio. The individual galloping observations were presented in a separate plot, which showed the ratios of the observed amplitudes to those indicated by the guide function. This two-step method of presentation seemed to have advantages in terms of clarity. The guide function is repeated here as Fig.1.

The enlarged collection is presented in Fig. 2. There, the individual cases are represented by the actual values of Ymax/S (in parts per thousand) rather than being referenced to the guide function. Thus, in Fig. 2, the symbol "17" would represent an observation where Ymax/S = .017, or an outage report where occurrence of flashover indicated that Ymax/S = .017 must have been attained.

IV. DISCUSSION

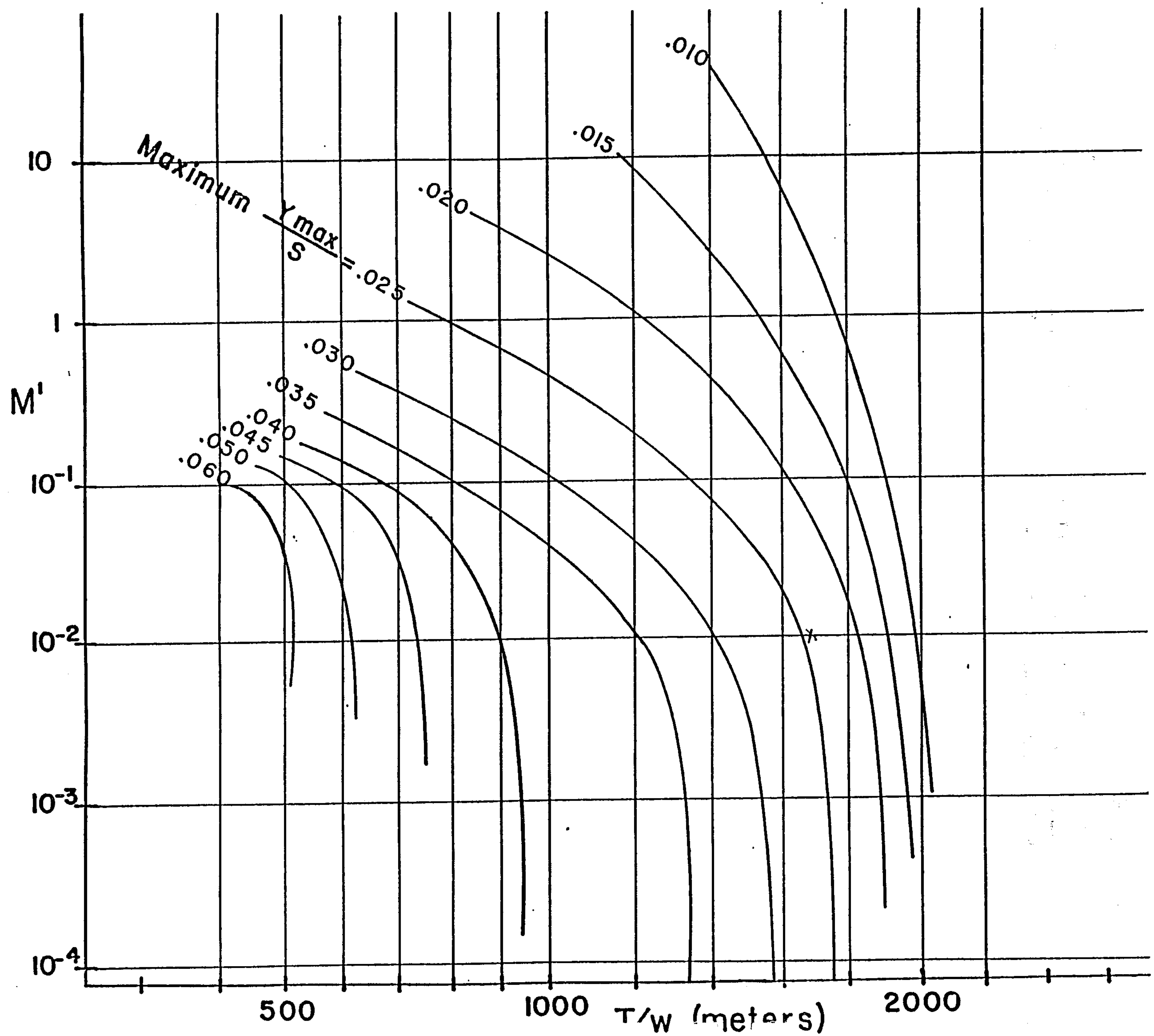
Comparison of the observational data in Fig. 2 with the guide function in Fig. 1 shows that several cases having high values of M' or T/w displayed amplitudes that significantly exceed the guide function. There are nine of these cases. Three of them were present in the previous collection as presented in the 1981 IEEE paper. These three represented very similar spans in the same locality in the same storm. It was thought that the storm may have been singular in its severity, so the guide function was not constructed to capture these cases.

Six of the newly-added cases also exceed the guide function. All of these cases are from the CORECH summary and appear to represent different localities, lines of different design and at least two different storms. These cases indicate that the three cases referred to in the previous paragraph should not be treated as exceptional but, rather, should be taken as indicating the levels of Ymax/S to be expected in spans having similar values of M' and T/w. These cases, and the six CORECH cases, lie above or to the right of the guide contour marked ".020".

The guide function of Fig. 1 will require revision in the region affected by these cases. That is being postponed for the present in the hope that yet more additional data will become available to support the process. Additional data would be particularly helpful for spans having M' around unity and T/w around 1200 metres and for spans with M' around 0.2 and T/w around 1800 to 2000. In the meantime, it is suggested that designers that use the guide function of Fig. 1 also refer to the case data of Fig. 2, when the guide points to a value of Ymax/S equal to or less than 0.02.

V. REFERENCE

1. C. B. Rawlins, "Analysis of Conductor Galloping Field Observations - Single Conductors", Trans IEEE Power Apparatus and Systems, Vol. PAS-100. No. 8 August 1981, pp 3744-53.


Maximum $\frac{Y_{max}}{S}$ = .025
.010
.015
.020
.030
.035
.040
.045
.050
.060
M'
10
1
10^{-1}
10^{-2}
10^{-3}
10^{-4}
500
1000
2000
T/W (meters)

4/55

Galloping Field Observation and Fault Experience Summary

Ymax/S in parts per thousand for Single Conductors.

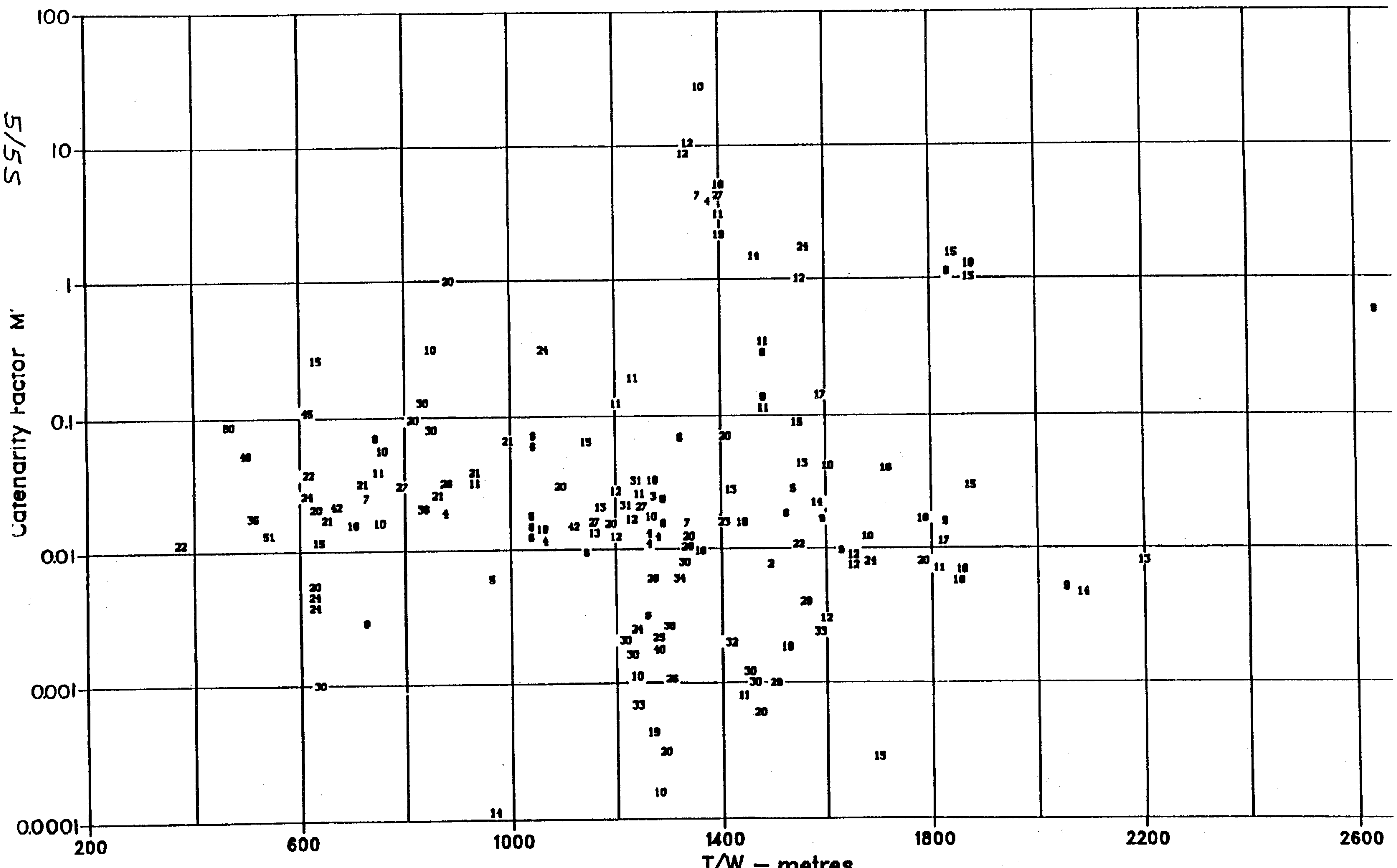


FIG 2