THE FIELD PRACTICE OF LAYING OUT CIRCULAR CURVES FOR RAILROADS

Published @ 2017 Trieste Publishing Pty Ltd

ISBN 9780649582549

The Field Practice of Laying out Circular Curves for Railroads by John C. Trautwine

Edited by Trieste Publishing Pty Ltd.
Cover @ 2017

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53 East Tenth Street, New York City.

THE

FIELD PRACTICE

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FOR

RAILROADS.

BY

JOHN C. TRAUTWINE, C. E.,

AUTHOR OF "THE CIVIL ENGINEER'S POCKET-BOOK," "A METHOD OF CALCULATING THE CUBIC CONTENTS OF EXCAVATIONS AND EMBANKMENTS," ETC.

REVISED BY

JOHN C. TRAUTWINE, JR., C. E.

THIRTEENTH EDITION.

NEW YORK:

JOHN WILEY & SONS,

53 EAST TENTH STREET.

1893.

PREFACE

TO THE

ELEVENTH EDITION.

THE publishers having informed me that they were about to issue a new edition, I endeavored to dissuade them from it, on the plea that the more comprehensive works of Henck, Searles, and Shunk (all of which, in addition to curves, treat on levelling and other field operations) were better adapted to the purposes of young assistants.

Their reply was that the continued demand for my book proved that some persons preferred to have the subject of curves in a portable form, by itself. Therefore, partly on that ground, and partly from a wish to show how some of the more useful problems may be applied to curves exceeding 180°, I assented to a new edition, and, rather hastily, prepared this.

The extension beyond 180° has not, I believe, been hitherto attempted, although its utility has of late years been made evident in the tortuous canyons of our Western States and of Mexico.

The additional matter has nearly doubled the number of pages.

The number of problems might be indefinitely increased by the aid of Euclid, or of any good modern work on geometry; but in fact very few are required in actual practice. Any extraordinary ones that may present themselves can be solved by a drawing. In preparing his drawing for this purpose, the young assistant need not always confine himself to such scales as may be managed by the common dividers; but when, as often happens, only a few chains of the curve need be drawn (including turnouts, etc.), he may with great ease lay them off on the same principle as in field operations, by using his

protractor, and either by long chords, or by tangential and deflection distances and angles; employing a scale of 3 to 12, etc., inches to 100 feet, and filling in the intervals, when required, by the table of ordinates. Even when the preliminaries of a curve have been found by calculation, it generally has to be run two or three times on the ground before it will fit perfectly; therefore a resort to a drawing does not necessarily increase the field work.

The description of the transit, and its adjustments, will, I trust, be found acceptable.

From Mr. Shunk's excellent "Field Engineer" I have adopted the term "*Apex Distance*," as preferable to the usual "*Tangent Distance.*"

In Art. 38 I suggest a new mode of easing-off the ends of curves.

The Table of Natural Versed Sines to 360° will be of use in curves of great arc.

It may prevent embarrassment to state that for what I call the "*Tangential*" angle, Mr. Henck afterwards adopted "*Deflection*" angle; and for my "*Deflection*" angle he employs "*Degree of Curve.*" Mr. Searles adopts Mr. Henck's terms, and Mr. Shunk mine.

In conclusion, owing to nervous prostration, I should not have been able to prepare this edition, but for the efficient aid of my younger son, J. C. T., Jr., upon whom nearly the entire labor devolved, and to whom I consider this acknowledgment due.

Under more favorable circumstances of health and limit of time, it is probable that in some cases neater solutions would have suggested themselves.

JOHN C. TRAUTWINE.

PHILADELPHIA, *July*, 1882.

PREFACE

TO

FIRST EDITION. 1851.

I HAVE been induced to prepare this little volume almost entirely with reference to the wants of the many young men who desire to qualify themselves for field service in an Engineer Corps. On that account, I have endeavored, by the use of the plainest language, to render the subject intelligible to *them*,—dispensing with that mathematical brevity which would have better accorded with the requirements of those who have already attained to some degree of proficiency in elementary field operations. Still, I trust that it will not prove unacceptable even to the latter.

The Table of Natural Sines and Tangents to single minutes, in a form sufficiently portable for field use, will supply a want which I have myself frequently experienced, not only in the operation of laying out curves, but on many other occasions.

One object in preparing it, was to furnish the profession with a Table that should be not only portable, but *absolutely reliable*. Those whose occupations compel them to resort to the Tables in common use, must have frequently experienced, like myself, the extreme embarrassment which attends the inaccuracies to which they are all subject. So long as a Table is known to contain a single error, the position of which is not ascertained, its employment is attended with doubt in every instance in which we are obliged to refer to it. On this account, I have not only prepared these Tables with the most scrupulous care, while in common type, but in order to render their accuracy a matter of certainty, I had them stereotyped, and afterwards revised three times with the utmost caution. I therefore feel no hesitation in saying that they may be depended upon *absolutely*. The same remark applies to the other Tables contained in the volume.

As Hassler's and Hutton's Tables of Natural Sines and Tangents are those most in use among the profession, it will be desirable to those persons who possess them to be able to correct the following errors, which I detected in comparing them.

In Hutton's Tables, Fifth Edition, 1811.

Sine of 6° 8′, for ·1063425, read ·1068425.
Page 328, at top, for 25 Deg., read 40 Deg.
Tangent of 44° 60′, for ·1000000, read 1·000000.
Tangent of 41° 60′, for ·8994040, read ·9004040.

In Dr. Gregory's Corrected Edition (the 8th) of Hutton's Tables, 1838.

Sine of 49° 14′, for ·7576751, read ·7573751.

In Hassler's Tables, 1830.

Sine of 78° 24′, read ·9795752.
Sine of 20° 60′, " ·3583679.
Sine of 66° 19′, " ·9157795.
Sine of 56° 39′, " ·8353279.
Sine of 55° 20′, " ·8224751.
Sine of 53° 4′, " ·7993352.
Sine of 48° 12′, " ·7454760.
Sine of 45° 3′, " ·7077236.

It is scarcely necessary to remark that, beyond 44°, the Sines, Tangents, etc., are read *upwards*, from the bottom of the page, using the corresponding column of minutes. To find the sine of an angle exceeding 90°, subtract the angle from 180°, and take out the sine of the remainder—because the sine of an angle, and that of what it wants of 180°, are the same.

JOHN C. TRAUTWINE.

PHILADELPHIA, 1851.

REMARKS.

The principle upon which railroad curves are laid out, is found in Euclid. It was employed in 1761, in tracing the northern boundary of the State of Delaware. Col. Stephen H. Long, of the U. S. Army, was the first person who reduced it, by means of appropriate rules and tables, to the form now in general use. Professor Rankine, in his "Civil Engineering," claims to have been the first to publish the method in 1843; but states that he had used it in 1841. Col. Long's "Railroad Manual," with full rules and tables for curves, was published early in 1829; and was in general use among Engineers throughout the United States for twelve years before the earliest date claimed by Prof. Rankine. Samuel W. Mifflin, C. E., of Pennsylvania, also published his "Railway Curves," based on the same principle, in 1837.

My first edition was in 1851. Mr. Henck's widely known standard "Field-Book for Railroad Engineers" followed in 1854.

J. C. T.

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