



NBRRI RESEARCH PAPERS

NO. 3.

SIMPLIFIED SPIRAL TRANSITIONS

NIGERIAN BUILDING AND ROAD RESEARCH INSTITUTE

P R E F A C E

A remarkable shortage of handy tables for computation of the elements of spiral transitions to circular curves was the incentive to produce this book. It is also very likely that spiral transitions with all their unquestionable advantages still are not commonly used in Nigeria because implementation procedures are much too complicated.

Presented here is a set of simple tables prepared by the author under the sponsorship of Nigerian Building and Road Research Institute (NBRRI) in an attempt to introduce a simplified version of spiral transitions combined with selected circular curves to Nigerian engineer's practice.

Each selection usually limits universality. However, in this case it has been determined that tested set of rounded radii of curves combined with rounded lengths of spirals covers most cases in everyday designer's and surveyor's practice in the field of highway and-railway engineering.

This book does not include special cases nor the theory of spirals which can easily be found in reference books.

HENRYK WALDEMAR MROCZEK

FOREWORD

Research Paper No. 3, "Simplified spiral transitions", is the first of a series of papers arising from the collaboration between the Nigerian Building and Road Research Institute (NBRRI) and outside organisations which have the capability to undertake research and development. Such a collaboration, when properly conceived and executed, can be mutually beneficial. It helps NBRRI to execute some of its research projects in a shorter period than would have been the case if it had handled them alone. In addition it involves the Universities and similar organisations in research projects directed towards achieving a national development goal, thereby enriching the contents of their course lectures.

The underlying policy of NBRRI towards such a collaboration is that it should be in projects approved for NBRRI by its supervising Ministry and Governing Board. Furthermore, the outside organisation should have the facilities and experienced research staff to execute these projects. In this regard, the Civil Engineering Department of Ahmadu Bello University has had a steady and enviable record in research and development. This paper is another testimony of their commendable performance.

One of the priorities in the research programme of NBRRI is providing professionals in the building and road construction industry with data, parameters and aids which can help them perform their functions quickly and effectively. In this regard, Research Paper No. 3, with its well tabulated figures should be an invaluable aid to all road design engineers, surveyors and technical officers responsible in setting out highway routes and roads. It is sincerely hoped that these tables will be widely used in the design and construction of roads. NBRRI will welcome any constructive feedback arising from their use.

A. O. MADEDOR
Director.
Dec. 1984

1.0 INTRODUCTION:

When the alignment of a highway changes from a straight line to a circular curve, the majority of drivers unconsciously react to the anticipated effect of centrifugal force by making a slight change in the direction they are driving: they turn the steering wheel relatively slowly at a uniform rate until they enter the circular curve. The sharper the curve the more the drivers tend to come closer to the center of the road when the road bends to the right, or to the right edge of the road when the road bends to the left, prior entering the curve. Some nonchalant drivers even try to "cut" the curve. All these above mentioned manoeuvres constitute an attempt to find a natural path of transition from straight to curve and to counter-act the centrifugal force gradually.

Mathematically, the shape of this curve may be approximated by a quite number of spirals, of which the CLOTHOID fits best.

In the majority of the countries spirals are recommended in highway design especially for curves with radius less than $R = 1000\text{m}$ and for relevant design speed. In Europe spirals are compulsory, but in the United States it depends on the policy of the particular State Highway Administration.

In railway design, where the train must follow exactly the railway track without freedom of lateral movement, unlike a car on the road, spiral transitions to the circular curves are compulsory.

The next chapters give guidelines for selection and computation of circular curves combined with their transitional spirals, and finally the tables for simplified plotting or staking-out spirals with circular curves are given.