A COMPARATIVE STUDY OF A PRECAST PRESTRESSED CONCRETE BRIDGE AND A STEEL COMPOSITE BRIDGE ON RED RIVER NEAR NORTH KILDONAN, MANITOBA

A Thesis

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by

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ABSTRACT

Preliminary investigation presented in this thesis shows that a precast prestressed concrete bridge would be economical to a steel concrete composite bridge on Red River near North Kildonan.

PREFACE

In recent years several continuous composite steel plate girder bridges have been constructed in this part of Canada because of lower cost and simplicity of their fabrication. However, much attention has not been given towards prestressed concrete which has been widely applied for bridge construction in Europe. The author has undertaken the task of making a comparative study of the two types of bridge. For this purpose preliminary designs have been made of a 750 foot bridge on the Red River near North Kildonan, using precast prestressed concrete girders in one case and welded haunched girders in the other.

The thesis is divided into five chapters. The first of these introduces the subject and presents the general features of the design. The second chapter contains the preliminary design of the steel composite bridge while the third deals with that of a precast prestressed concrete bridge. The fourth chapter compares the costs. In the fifth a general discussion is presented and conclusions are drawn.

The writer wishes to express his gratitude to Professor Ronald Lazar for his guidance and help and to Professor W. F. Riddel for his advice and suggestion. Grateful acknowledgement is made to Mr. A.G. Burrows of Public Works Department and Mr. Donald Elliott of Preco Ltd., for providing useful data. Special thanks is extended to the Canadian Commonwealth Scholar-

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TABLE OF CONTENTS

TABLE OF CONTENTS CONTINUED

CHAPTER ONE

CHAPTER I

INTRODUCTION

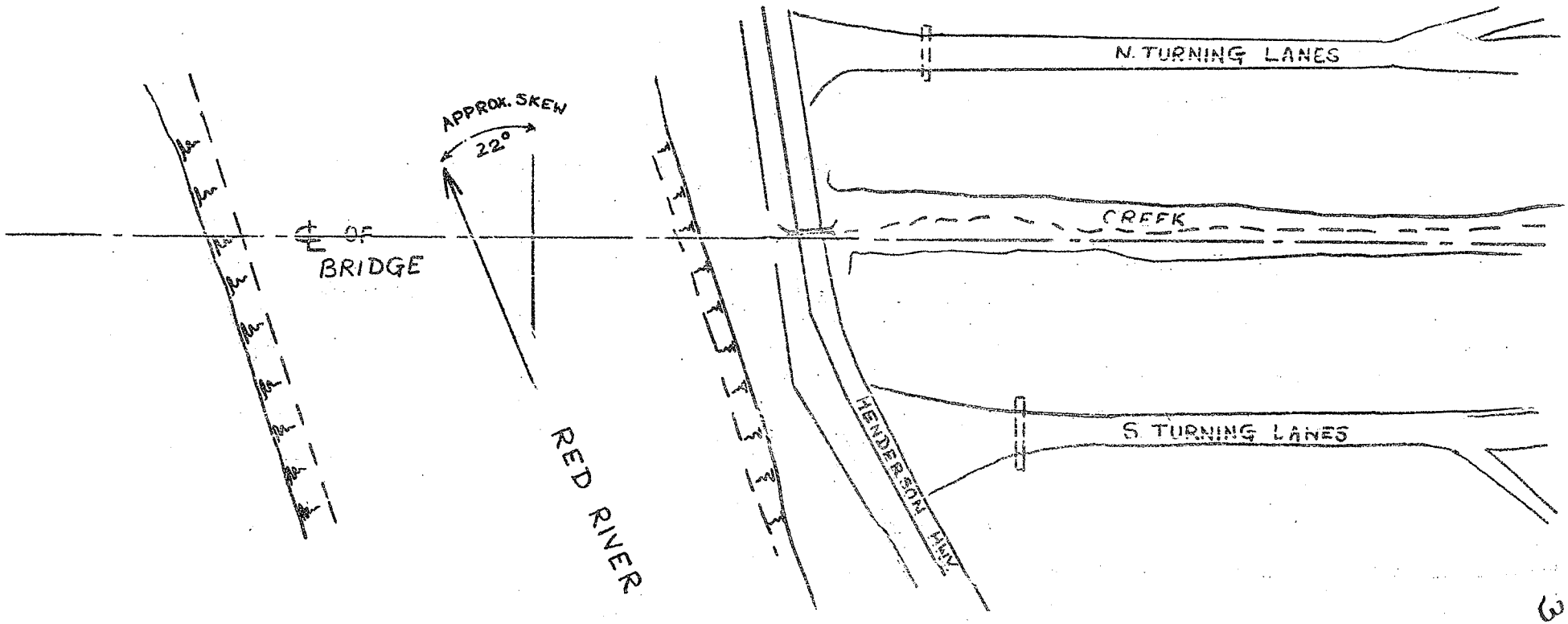
With the development of welding technique the use of continuous welded haunched girders for bridge construction is increasing steadily. These bridges consist mostly of prefabricated steel plate girders and cast-in-place concrete deck slab resting directly on the girders. In the positive moment zone, the slab is fixed with the girders by welded shear connectors and thus the slab is utilized to form a composite section to carry live loads and all dead loads added after the deck has hardened. By this method and also by eliminating riveted joints it is possible to save considerable amount of steel. Most of the bridges constructed in this region during the past few years were of this type as they were found economical.

However, prestressed concrete bridges which are equally versatile, are fast becoming popular in North America. Unlike Europe, economic considerations here have restricted the use of post-tensioning of situ-cast girders, and most of the prestressed concrete bridges built in the United States have used a series of simple spans. Recently a method of establishing continuity between precast girders has been used in the United States which consists of placing deformed bar reinforcement in the situ-cast deck slab across the girder supports to resist negative bending moment due to live load. Post tensioned

continuity connections, used extensively in Europe, involve considerable field labour and have not received much attention in North America. The Portland Cement Association tested continuity connections using deformed bar reinforcement and achieved one hundred per cent continuity under live loads. This type of connection have been successfully used by the State of Ohio on a bridge over Scietu River. The object of this thesis is to investigate whether this type of bridge could be economically constructed in this region to replace the conventional steel composite bridge. For this purpose, preliminary design and cost analysis have been made of a bridge on the Red River, near North Kildonan, using precast prestressed concrete girders in one case and welded steel girders in the other. The Department of Highways is going to construct a bridge on this particular site to run the North Perimeter Highway. The layout plan, elevation profile, etc., were obtained from them and used in the designs with slight modifications to simplify the problem. No separate study was therefore necessary. The overall length of the bridge including overpass is 1390 feet but only the 750 feet bridge proper has been taken into consideration.

FIGURE 1.

Actual Plan of the Bridge Site



Scale: 1 inch = 200 feet.

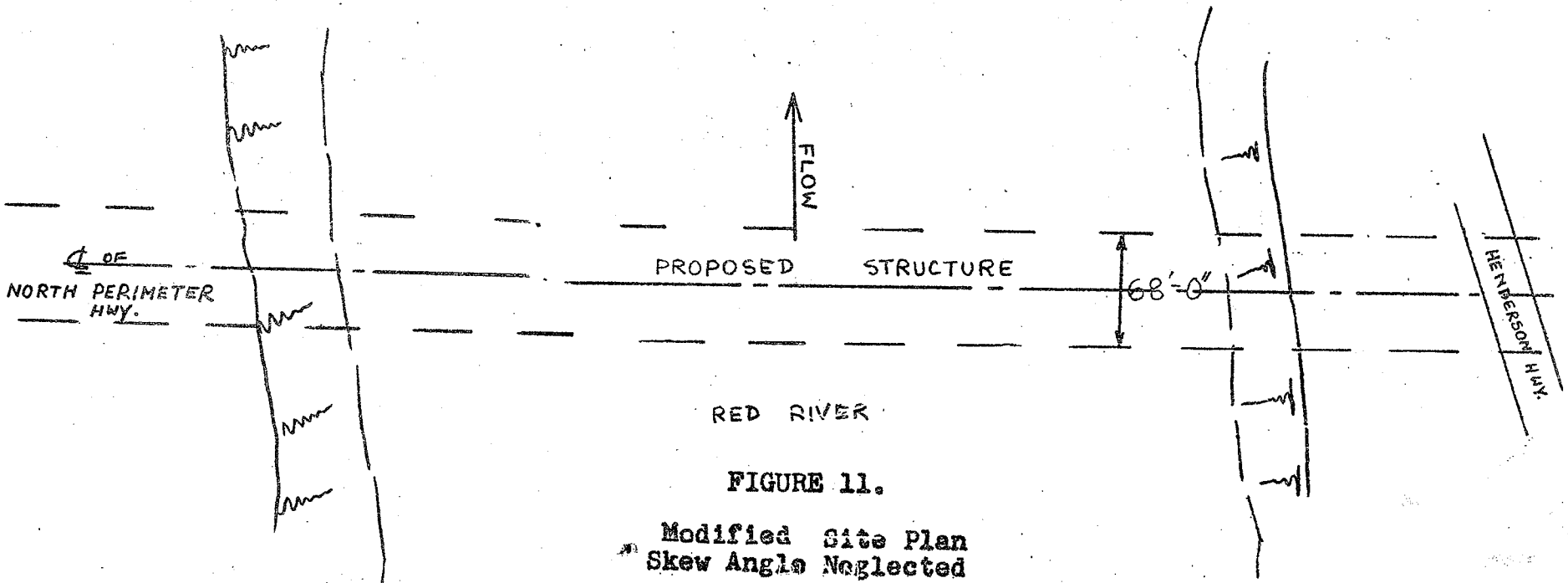


FIGURE 11.

Modified Site Plan
Skew Angle Neglected

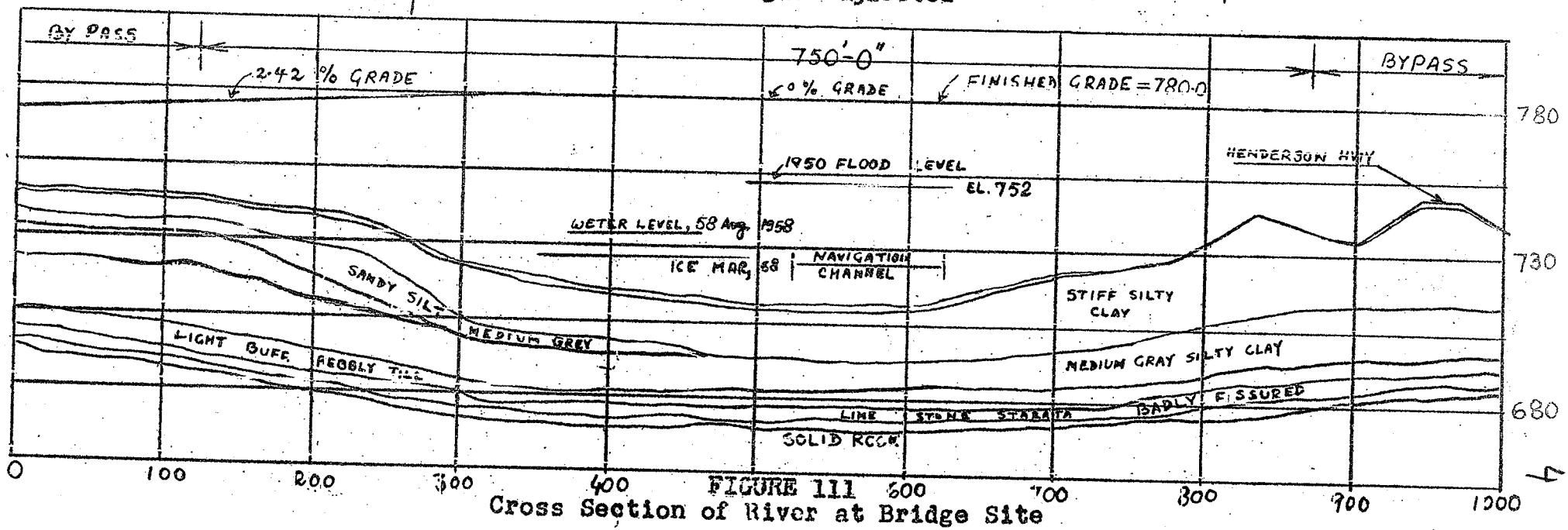


FIGURE 111
Cross Section of River at Bridge Site