REINFORCEMENT FOR SHRINKAGE AND THERMAL CRACKS CONTROL

by
Abdullah Hasan

June 1984

IMPERIAL COLLEGE OF SCIENCE AND TECHNOLOGY

(University of London)

Department of Civil Engineering

MSc Dissertation

REINFORCEMENT FOR SHRINKAGE AND THERMAL CRACKS CONTROL

by

A. Hasan

MSc Concrete Structures

June 1984

CONTENTS

1 INTRODUCTION

A well known fact to all engineers is that concrete is weak in tension and will crack when its tensile strength is exceeded. Cracking does not necessarily indicate the start of structural disintegrity, unless the cracks are of severe nature.

The purpose of cracks control is not to prevent the cracks from developing, but to ensure that the structure is serviceable. The basic principle of cracks control by reinforcement is to distribute the cracks into an acceptable pattern of fine, closely spaced cracks rather than an unsightly isolated wide cracks. It is generally felt that these cracks should be kept as small as possible. Wide cracks will impare the appearance of the structure, may allow the ingress of deleterious substances,and give rise to the problem of leakage and spalling of concrete. Penetration of corrosive element may result in the corrosion of steel which can lead to the weakening of the structure.

The importance of cracks control is recognised in most Standards and Codes. Most of them limit the cracks width according to environmental exposure. The limits of crack width range from a typical value of 0.1 mm for very corrosive environment to 0.4 mm in protected environment. Internationally, there appears to be a good agreement on the subject of crack width limits and most Codes recommend values which do not differ greatly from one another. However, current opinion suggests that these crack width limits are not properly based on research evidence.

There are many structures which have displayed severe cracking without excessive external loading. The reason has been attributed to restrained

shrinkage and thermal contraction of concrete. Shrinkage and thermal cracking is common to slabs and walls such as water retaining structures, retaining walls, concrete pavement and ground slabs, where the joints are far spaced. Thus, cracks control by reinforcement is very important in continuous walls or slabs. Due importance should be given to the understanding of these cracks and the approach to the problem.

This dissertation is basically a literature survey and will attempt to present the subject of shrinkage and thermal cracks control by using reinforcement in reinforced concrete structures. There are several methods by which these cracks can be controlled, but this dissertation is only confined to reinforcement. It discusses the factors affecting the movement and goes on to derive the general formula for predicting crack width, crack spacing and the amount of reinforcement required. A brief flexural crack approach is also given for comparison. At the later part of this dissertation, it will discuss the design parameters and criteria for limiting crack width.

shrinkage and thermal contraction of concrete. Shrinkage and thermal cracking is common to slabs and walls such as water retaining structures, retaining walls, concrete pavement and ground slabs, where the joints are far spaced. Thus, cracks control by reinforcement is very important in continuous walls or slabs. Due importance should be given to the understanding of these cracks and the approach to the problem.

This dissertation is basically a literature survey and will attempt to present the subject of shrinkage and thermal cracks control by using reinforcement in reinforced concrete structures. There are several methods by which these cracks can be controlled, but this dissertation is only confined to reinforcement. It discusses the factors affecting the movement and goes on to derive the general formula for predicting crack width, crack spacing and the amount of reinforcement required. A brief flexural crack approach is also given for comparison. At the later part of this dissertation, it will discuss the design parameters and criteria for limiting crack width.