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AN EXAMINATION OF THE EFFECT OF DIFFERENTIAL SETTLEMENT ON FRAMES

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INTRODUCTION

1. Statement of the problem

Damage to a structure is usually attributed to the failure of structural members or of the foundation. In general, the design of a structure is separated into two parts. The structural engineer designs the superstructure only and puts the focus on the fiber stresses in the members subjected to external loads. The soil engineer uses the loads transfered from the superstructure and considers only the soil condition to design the foundation. If a building settles uniformly the stresses in the members of the structure are not increased. However, uniform settlement is usually not the case. Differential settlement must be considered inevitable for most structures unless the foundation is supported by solid rock. Thus differential settlement may govern both the design of the foundation and of the superstructure. If the design of the structure is conservative enough to prevent cracks or large distortions it is considered a good design. When distortions become evident the foundation is immediately suspected even though a change in structural design to prevent large carry-over of loading might have avoided the distress. Both foundation design and structural design should thus take into account the consequences of differential settlement in main load-carrying members. Recognition of this fact can result in considerable savings in construction cost, without reduction in the factor of safety, since a more properly balanced design is produced.

2. Purpose of the study

Conventional structural design of a framed structure involves computation of stresses in the members for the various loading conditions without differential settlement. The stress change in each member of a frame due to yielding supports can be treated by the same techniques. If the differential settlement can be predicted with reasonable accuracy, and if the design of both superstructure and foundation take into account the reactions and moments caused by the settlement, such a procedure may make the structure design more economical and safe.

In this report reinforced concrete frames with multiple stories and bays are analyzed for the purpose of examining the effect of differential settlement on the frames.

3. Scope of the study

Parts of the structure of Haymaker Hall at Kansas State University were taken as examples in order to examine the effect of differential settlement on various superstructures.

The analyses were carried out by using STRUDL II (1)*, a computer program designed by Massachusetts Institute of Technology, for structural analysis. The program was run on the IBM 360/50 computer at the Kansas State University Computing Center.

The computed results were presented and compared to each other in order to examine the effect of differential settlement on the frames.

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* Numerals in parentheses refer to corresponding items in R References.