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FINITE ELEMENT METHOD ANALYSIS
OF WIDE-FLANGE BEAM WITH REINFORCED OPENING

by

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A MASTER'S REPORT

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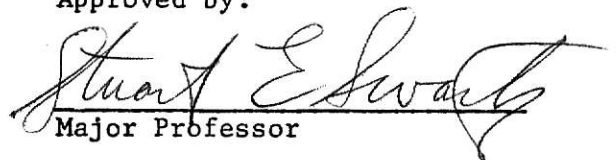
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Table of Contents

	page
Table of Figures	iv
I. Introduction	1
II. Literature Review	3
III. Method of Analysis	9
A. Introduction	9
B. The Direct Stiffness Method	11
(a). Evaluation of Element Force-Displacement Equation	11
(b). Transformation of the Element Stiffness Matrix	11
(c). Assembly of the Total Stiffness Matrix	12
(d). Determination of Nodal Displacements	13
(e). Determination of Stresses	14
(f). Comments on the Total Stiffness Matrix	14
C. Formulation of Finite Element Method	16
(a). Introduction	16
(b). Plane Stress in Plate - triangular element	17
IV. Numerical Examples	26
A. Review of Experimental Set Up	26
B. Simplification of the Problem	29
C. Discretization	30
D. Superposition	32
(a). Displacement Boundary Conditions	39
(b). Consistent Nodal Loads	39

	page
V. Presentation and Comparison of Results	45
A. Normal Stresses	45
B. Shear Stresses	47
VI. CONCLUSIONS	64
References	65
Acknowledgements	68

Table of Figures

	page
1. Web Opening and Reinforcing Details	2
2. The Ideal Reinforcement	4
3. Element Assembly	13
4. Element Incidences	18
5. Experimental Set Up	27
6. Beam Dimensions of Actual and Idealized Cross Sections	28
7. Portion of Beam Used in Analysis	29
8. Discretization of a Deep Beam	31
9. Example I: Plate with Pure Bending	33
10. Six Discretizations for Example I	34
11. Example II: Cantilever Plate Subjected to End Shear	35
12. Discretizations for Example II	36
13. The Effect of the Nodal Point Numbering System on the Band Width of the Stiffness Matrix	37
14. Finite Element Discretization for the Report	38
15. Superimposed Loading Conditions	40
16. Displacement Boundary Conditions	41
17. Consistent Nodal Loads for Pure Bending	43
18. Consistent Nodal Loads for End Shear	43
19. Normal Stresses from Different Approaches for $M/V = 80''$	48
20. Normal Stresses from Different Approaches for $M/V = 60''$	49
21. Normal Stresses from Different Approaches for $M/V = 40''$	50

	page
22. Normal Stresses from Different Approaches for $M/V = 20''$	51
23. Effects of Reinforcement on Normal Stresses for $M/V = 80''$	52
24. Effects of Reinforcement on Normal Stresses for $M/V = 60''$	54
25. Effects of Reinforcement on Normal Stresses for $M/V = 40''$	57
26. Effects of Reinforcement on Normal Stresses for $M/V = 20''$	59
27. Shear Stresses from Different Approaches	62
28. Effects of Reinforcement on Shear Stresses.	63

I. INTRODUCTION

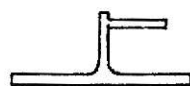
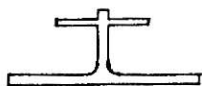
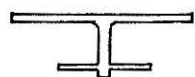
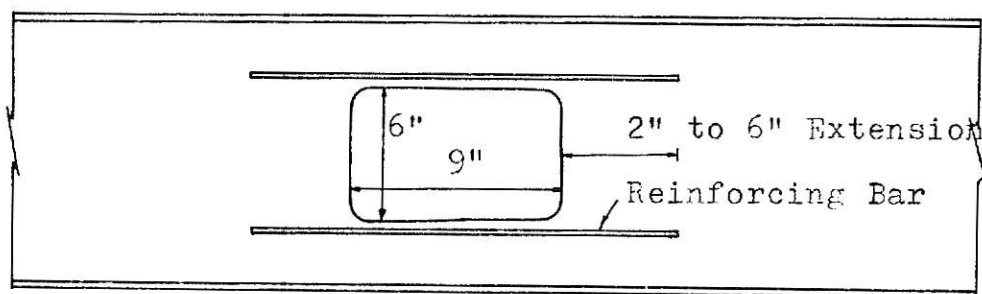
In many buildings, openings through the webs of steel beams are required either for access or for utility installations. Therefore, to find an economic and convenient method for cutting openings and fabricating appropriate reinforcement is necessary. Before 1960, there were more than 70 publications^{1,2*} which, either in Russia, or the United States, or other countries, reported on stress concentrations for small round holes through plate and beam webs. In the past few years, researchers have been endeavoring to investigate larger rectangular openings through beam webs. Both analytical and experimental investigations have been made of various openings with and without reinforcing. These investigations were concerned with the stress concentration factor, the necessity for reinforcing, the amount of reinforcing, the location of reinforcing, and the effect of different moment-shear (M/V) ratios for various types of reinforcement.

An investigation has been carried out at Kansas State University³ including 16 elastic tests, 3 plastic tests and theoretical analyses by using the Vierendeel truss concept for a 6"x9" rectangular web opening at the middepth of a W12x45 steel beam subjected to 4 different loadings with various M/V ratios.

The purpose of this report was; (1) to find an analytical solution by evaluating a reasonable element mechanism to simulate the beam behavior

*Superscripts refer to items listed in the References.

with web opening using the finite element method with the ICES-STRUDL computer program, (2) to compare the effects of different lengths of reinforcing bar (see Fig. 1) for a wide-flange beam with web opening, and (3) to obtain a comparison with experimental results and analytical results based on Vierendeel assumptions presented in reference 3.



Two-sided Reinforcing

One-sided Reinforcing

Fig. 1 Web Opening and Reinforcing Details