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Project Title/Work Order		EDT No. 607248
WHC-SD-CP-ES-160, Rev. 0, Seismic (SSE) Evaluation for the 291Z Stack at the Hanford Site - Addition of Environmental Monitoring Penetrations		ECN No. N/A

Name	MSIN	Text With All Attach.	Text Only	Attach./ Appendix Only	EDT/ECN Only
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ENGINEERING DATA TRANSMITTAL

Page 1 of 1

1. EDT 607248

2. To: (Receiving Organization) P. Sullivan, PFP Operations	3. From: (Originating Organization) Structural Assessments, 8D440	4. Related EDT No.: N/A
5. Proj./Prog./Dept./Div.: E25677	6. Cog. Engr.: J. T. Baxter	7. Purchase Order No.: N/A
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16. KEY

Impact Level (F)	Reason for Transmittal (G)		Disposition (H) & (I)	
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1, 4	1/4	Cog. Eng., P. Sullivan	[signature]	8/22/94	T5-54						
1, 4	1	Cog. Mgr., D.J. McBride	[signature]	8/22/94	T5-54						
1, 4	1	QA P.J. Hassmann	[signature]	8/25/94	T4-19						
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18. J. T. Baxter [signature] 7-25-94 Signature of EDT Originator / Date	19. SEE 16. ABOVE JTB P. Sullivan Authorized Representative for Receiving Organization / Date	20. T.J. Conrads [signature] 8/31/94 Cognizant/Project Engineer's Manager / Date	21. DOE APPROVAL (if required) Ltr. No. [] Approved [] Approved w/comments [] Disapproved w/comments

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Document Title:	SEISMIC (SSE) EVALUATION FOR THE 291Z STACK AT THE HANFORD SITE - ADDITION OF ENVIRONMENTAL MONITORING PENETRATIONS
Release Date:	8/30/94

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SUPPORTING DOCUMENT

1. Total Pages 98

2. Title

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3. Number

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6. Author

Name: J. T. Baxter

J. T. Baxter 6-22-94

Signature

Organization/Charge Code 8D440/E25677

7. Abstract

Report reviews the as-built condition of the 291Z stack, modifications to the stack since original design, and the effect of planned penetrations on the seismic qualification of the stack as reported in SD-CP-SAR-016, Rev. 0, Vols 1 and 2.

9. Impact Level 2SQ

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DATE AUG 31 1994

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SEISMIC (SSE) EVALUATION FOR THE 291Z STACK AT THE HANFORD SITE - ADDITION OF ENVIRONMENTAL MONITORING PENETRATIONS

WHC-SD-CP-ES-160

NOVEMBER, 1993

Prepared by: L. A. Rodgers — 2/2/94 Date
Component Structural Analysis

Reviewed by: J. T. Baxter — 2/2/94 Date
Structural Margin Assessments

Approved by: T. J. Conrads — 6-22-94 Date
Structural Margin Assessments

WESTINGHOUSE HANFORD COMPANY
Hanford Operations and Engineering Contractor
for the Department of Energy

SEISMIC (SSE) EVALUATION FOR THE 291Z STACK AT THE HANFORD SITE - ADDITION OF ENVIRONMENTAL MONITORING PENETRATIONS

CONTENTS

LIST OF FIGURES AND TABLES

1.0 EXECUTIVE SUMMARY

The purpose of this 291Z stack analysis is to determine the structural effects of chipping additional holes into the stacks concrete walls. The proposed holes are for new environmental monitoring sample probes to be installed at three different elevations. The approximate elevations proposed at this time are 50 ft, 135 ft and 175 ft. There will be four holes required at each of the elevations to support two sample probes extending across the diameter of the stack. The holes are to be 6 in to 8 in in diameter and are to be arranged at approximately 90 degree separation around the circumference of the stack.

A structural sensitivity study has been completed to assess the effect of the proposed holes on the baseline seismic qualification of the stack completed by URS/John A. Blume & Associates, Engineers, San Francisco, California (URS/Blume) in August, 1988. Results of the URS/Blume analyses are documented in SD-CP-SAR-016, "Seismic (SSE) Evaluation for the 291Z Stack at the Hanford Site" (URS/Blume, 1988). Results of the sensitivity study indicate that the stack would still have adequate structural moment capacity if the new holes were drilled cutting the vertical strength reinforcing steel, or if existing penetrations added since original construction have inadvertently cut vertical rebars. For current and future modifications, no vertical rebar should be cut. A limited number of horizontal rebar, no more than 2, may be cut at the new hole locations without significantly influencing the stack structural shear capacity.

New penetrations in the 291Z stack should not be located below elevation 47 ft - 4 in due to rebar layout and the fact that maximum seismic structural loads occur below this elevation. No vertical rebar should be cut when chipping the new penetrations in the stack concrete wall for the environmental monitoring equipment. Quality assurance records shall be obtained during construction to verify the as-built integrity of the vertical rebar adjacent to the new hole locations and the number of horizontal rebar cut at each penetration.

Wind load qualification was reviewed. Seismic loads govern over wind loads for all structural load cases; therefore no additional wind analyses are required.

The authors reviewed the URS/Blume report in some depth during development of this analysis. Conclusions in the URS/Blume report about inelastic cracking between elevations 10 ft and 45 ft may be overly conservative because of the discretization scheme used for the lumped parameter model. There appears to be additional structural capacity at these elevations that was not considered in the URS/Blume evaluations. Any future analyses should revisit the capacity evaluations in these areas prior to proceeding to more elaborate analysis schemes.

2.0 ANALYSIS

The stack was evaluated in the baseline URS/Blume study as a seismic "three over one" problem. Although the stack is only a safety class three structure; its failure and collapse could impact a safety class one structure, the 234-5Z Building. Thus, the seismic qualification of the stack was based on seismic loadings appropriate for safety class one structures. The URS/Blume report includes: (1) parametric dynamic lumped parameter soil-structure interaction seismic analyses of the stack structure (ADINA code); (2) concrete shear and bending strength evaluations for the stack cross-sections (RCCOLA code); and (3) a non-linear concrete cracking rebar elasto-plastic model of the lower stack section (ADINA code).

The proposed 8 in diameter holes are very small compared to the overall stack dimensions, 18 ft base diameter by 200 ft height. Stack wall concrete thickness varies from 9 in at the base to 6 in at the top. The response of the stack to dynamic or other load inputs will not be significantly affected by the concrete and rebar removed from these small holes. Therefore the existing stack load demands as calculated by URS/Blume will not change and are used in this analysis to evaluate the stack with the proposed holes.

The change in the stacks local moment and shear capacity because of the concrete and rebar removed from the holes and the orientation of the hole pattern is evaluated. Because of the stacks circular geometry two orientations were chosen for evaluation in a sensitivity study of the stack structural capacity. One with the holes perpendicular to the principal bending moment axis and the second with the holes orientated at 45 degrees from this axis.

URS/BLUME MODELS - Results from the original URS/Blume study are shown in Figures 2-1 through 2-4. The lumped parameter uncracked dynamic stick model of the 291Z stack is shown in Figure 2-1. Model elements include 11 nodes, 11 nodal masses, 10 beam elements, a rigid link and a set of soil springs. Figure 2-2 shows the stack maximum moment demand profile determined from dynamic time-history analysis compared to the structural moment capacity profiles for this model over the full height of the stack. From this figure it is seen that the ratio of ultimate moment capacity to demand is lowest at elevation 22 ft - 6 in. Looking at the distribution of demand and capacity over the height of the stack, the demand exceeds yield capacity from around 5 ft elevation to the 58 ft elevation. Similar curves are shown in Figure 2-3 for shear demand and capacity. This figure shows that the stack shear capacity for the uncracked stick model greatly exceeds the demand. Thus, shear is not a problem and is not further reviewed in this evaluation. The critical engineering characteristic of the stack to be reviewed in this analysis is therefore the bending capacity of the stack at and above the 45 ft elevation.

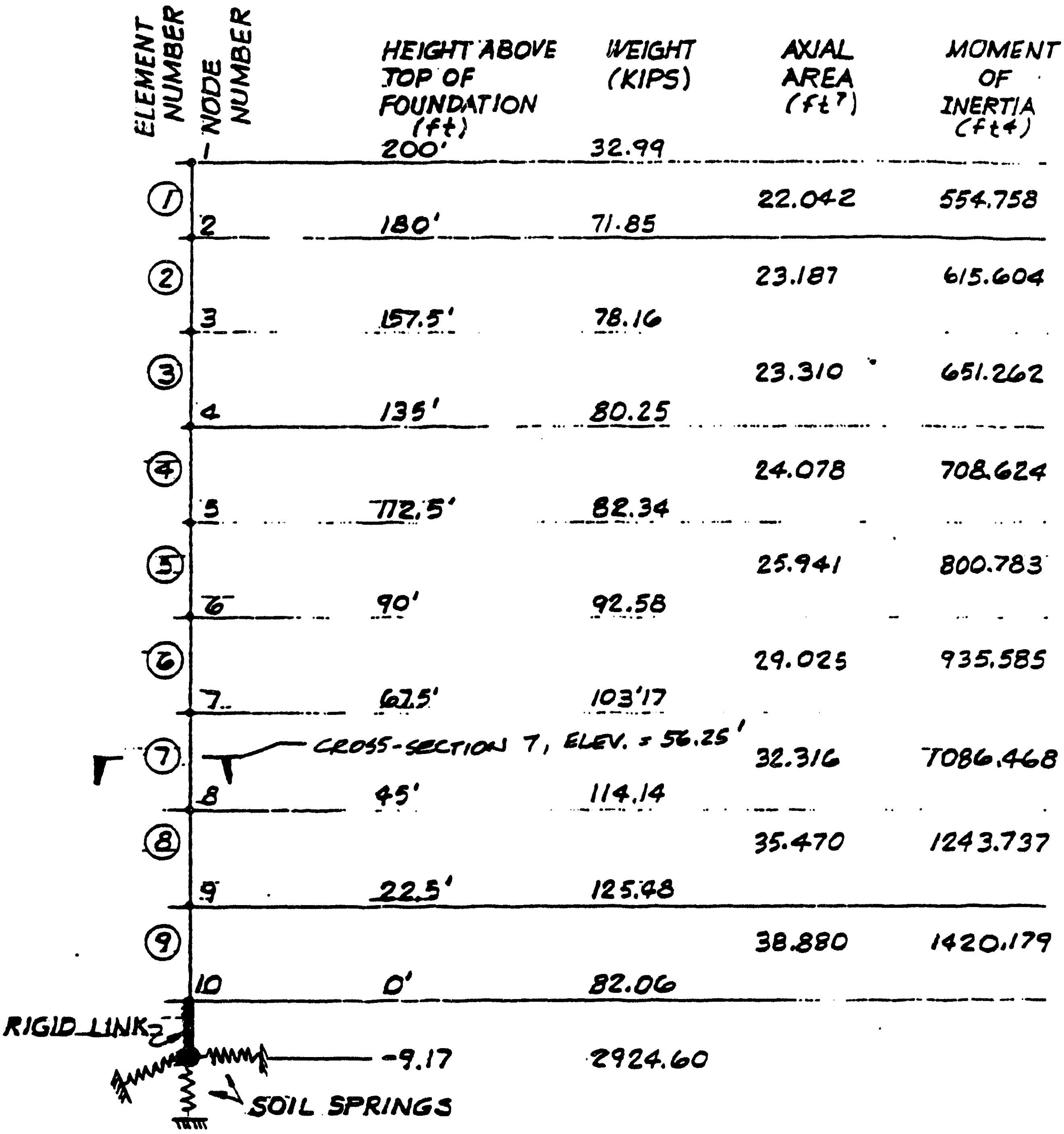

Figure 2-1. Stick model (uncracked) representation of 291Z stack. (Ref. URS/Blume, 1988, Vol. 1, pg 34)

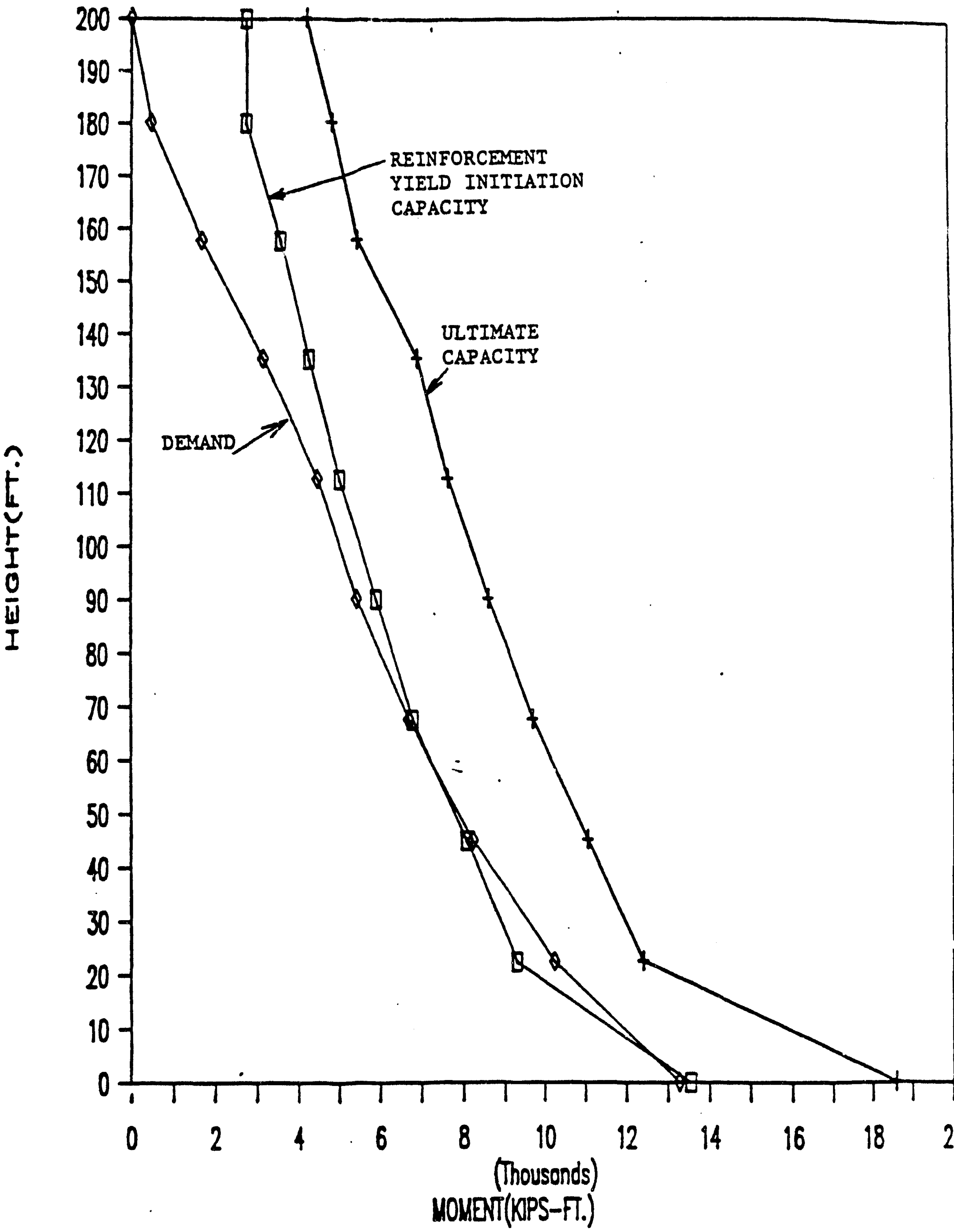

Figure 2-2. **Maximum moment demand profile of uncracked stick model, and the moment capacity profile of the stack.**

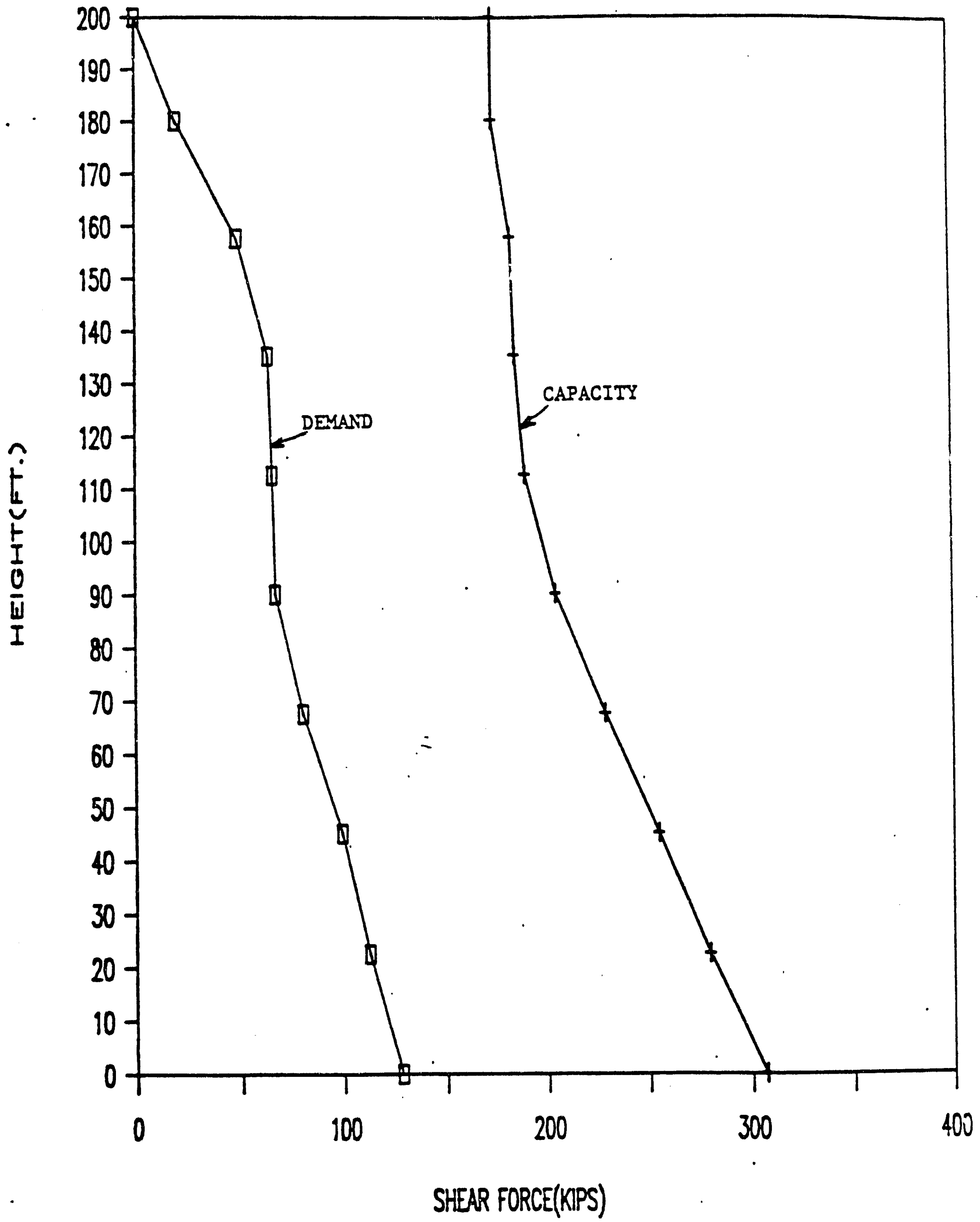

Figure 2-3. Maximum shear demand profile of uncracked stick model and shear capacity profile of the stack.