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DESIGN AND CONSTRUCTION OF THE CHARLES LEE POWELL STRUCTURAL SYSTEMS LABORATORY

by

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PREFACE

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J. L. Noland

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by

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A B S T R A C T

The Charles Lee Powell Structural Systems Laboratory at the University of California, San Diego provides with a 120 x 50 ft (37 x 15 m) box girder test floor and a 50 ft (15 m) high reaction strong wall the necessary environment to test not only large structural components but also full scale structural systems under critical loads. The reaction wall and the high bay facility allow full scale testing of five story buildings under simulated seismic loads and the capacities and dimensions of the test floor can accommodate the full scale testing of bridge components under simulated traffic and overloads. The full scale structural systems testing will render the long needed experimental capabilities to validate complex analytical models and to verify and substantiate new or existing structural design procedures.

This report is intended as a source of information to researchers in need of a large scale reaction wall facility. All pertinent design concepts, dimensions and capacities are described and detailed documentation of the construction of the laboratory is provided. Test load capacities for the reaction wall and the box girder test floor are derived together with dynamic and stiffness characteristics to serve as the basis for test setup designs. Strain data obtained from permanently installed gages at the base of the reaction wall is documented during and after the post-tensioning operation of the strong wall.

It is hoped this report will inspire the use of this unique facility to its full capacity.

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1. INTRODUCTION

The basic understanding of structural behavior, particularly in the post-working stress and failure range, relies heavily on observed damage and failure behavior of actual structures during or after natural disasters. Detailed understanding can only be obtained by experimental structural research in controlled testing environments.

Experimental testing of components, sub-assemblages, and complete structural systems is necessary to provide a constitutive data base and verification for analytical models developed to simulate the complete behavior of structural systems under critical loads. Local failure behavior is generally studied by large scale structural component testing, while the overall behavior of structural systems is investigated using scaled down experimental models. However, both component testing and scaled models cannot answer questions concerning force redistribution capabilities of successively damaged highly redundant structural systems, their global and local failure behavior, and the effectiveness of possible repair, rehabilitation, or retrofitting measures.

Only recently the erection of large reaction walls in conjunction with servo-controlled on-line testing equipment has allowed the full scale testing of complete structural systems under critical loads such as seismic loads, overloads, or failure loads.

A recommendation on "Experimental Research Needs for Improving Earthquake Resistant Design of Buildings" by a workshop of the EERI Committee on Experimental Research [1, 2] concludes that for earthquake engineering research in the U.S., "...the understanding of structural behavior under earthquake excitations would be greatly enhanced by the construction of two or three facilities whose design is centered around a reaction wall system," and "...one reaction wall facility with the capacity to test structures with heights of at least 40 ft (12 m) is needed."

The Charles Lee Powell Structural Systems Laboratory at the University of California, San Diego, has been constructed in direct response to the aforementioned need [3, 4, 5]. This Laboratory is the first facility in the U.S. with a 50 ft (15 m) reaction strong wall (see Fig. 1) for the full scale testing of up to five story buildings under simulated seismic loads (see Fig. 2). This laboratory will complement existing reaction wall facilities of up to 20 ft (6 m) in height at The University of Texas, Austin [6], and at The University of Michigan, Ann Arbor [7], as well as a 45 ft (14 m) buttress at the National Bureau of Standards Large Scale Structural Research Facility in Gaithersburg, Mary-

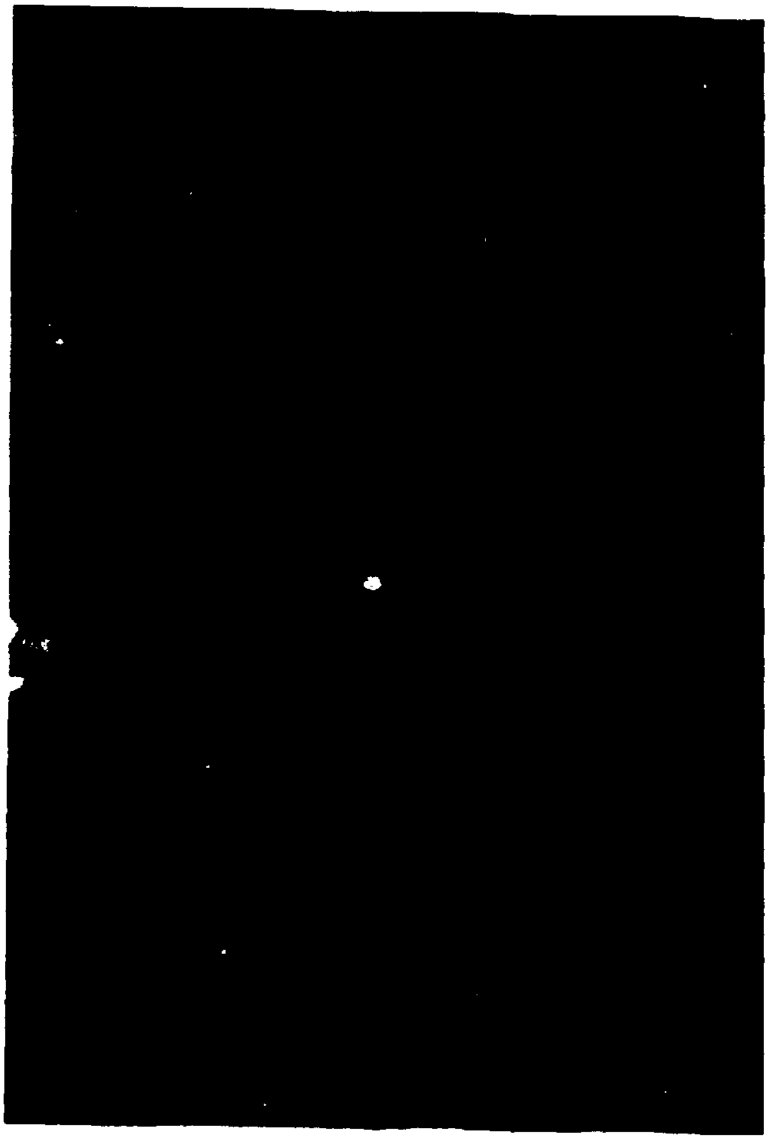


Fig. 1 Completed UCSD Structural Systems Laboratory with Drs. Hegemier and Seible in Front of the 50 ft High Reaction Wall

land. The design and construction of the UCSD full scale testing facility is discussed in this report.

The main emphasis of this report is given to a detailed description of the parameters and criteria which governed the design as well as a detailed description of the construction of the four cell box girder test floor as depicted in Fig. 3 and the heavily post-tensioned reaction strong wall as shown in an overview in Fig. 4.

Test load capacities for both the test floor and the reaction strong wall are derived and discussed and strain records obtained during the construction and the post-tensioning of the reaction wall as well as time-dependent effects since the time of construction are presented.

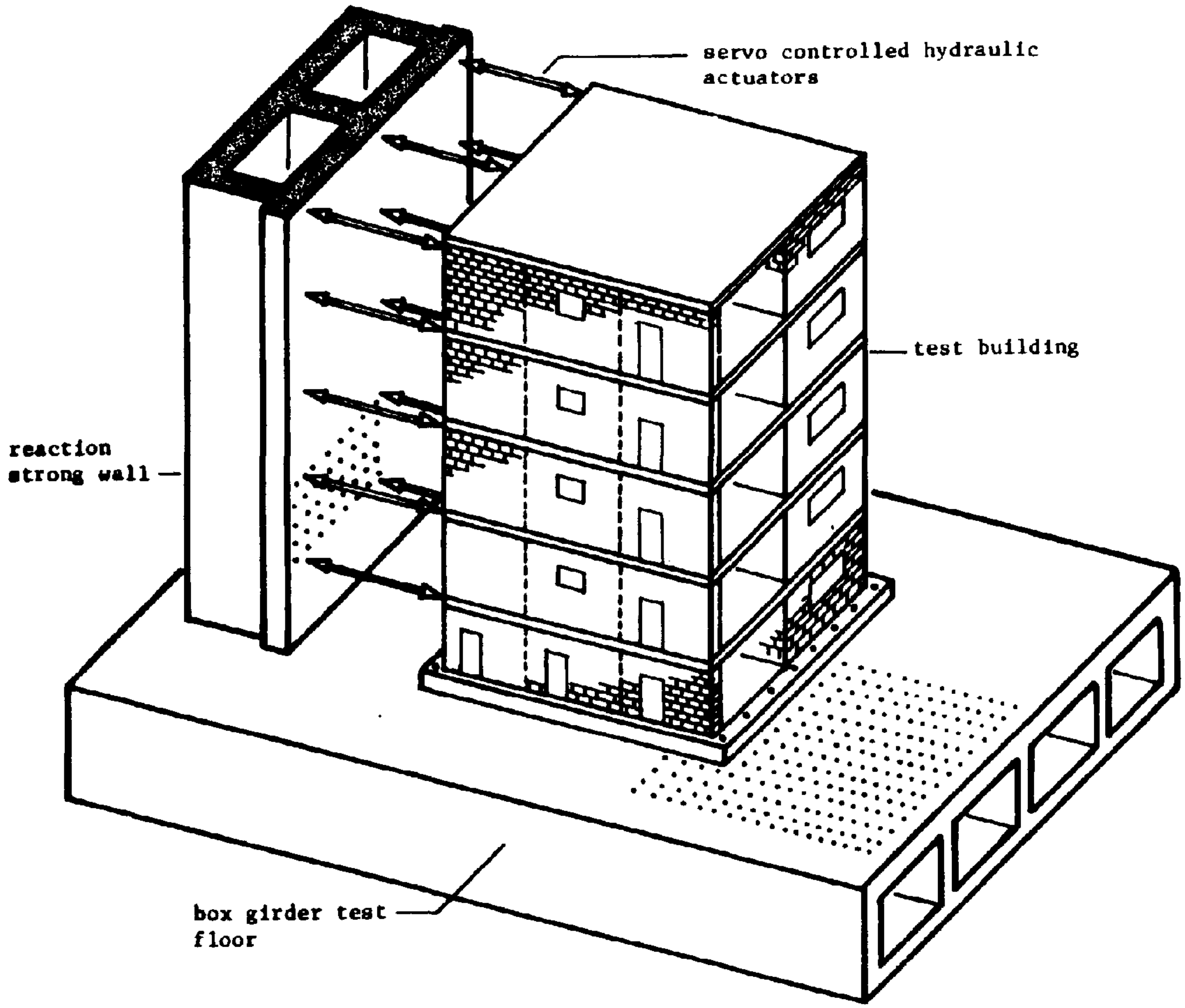


Fig. 2 Schematic Test Setup for a Five Story Full Scale Building Test

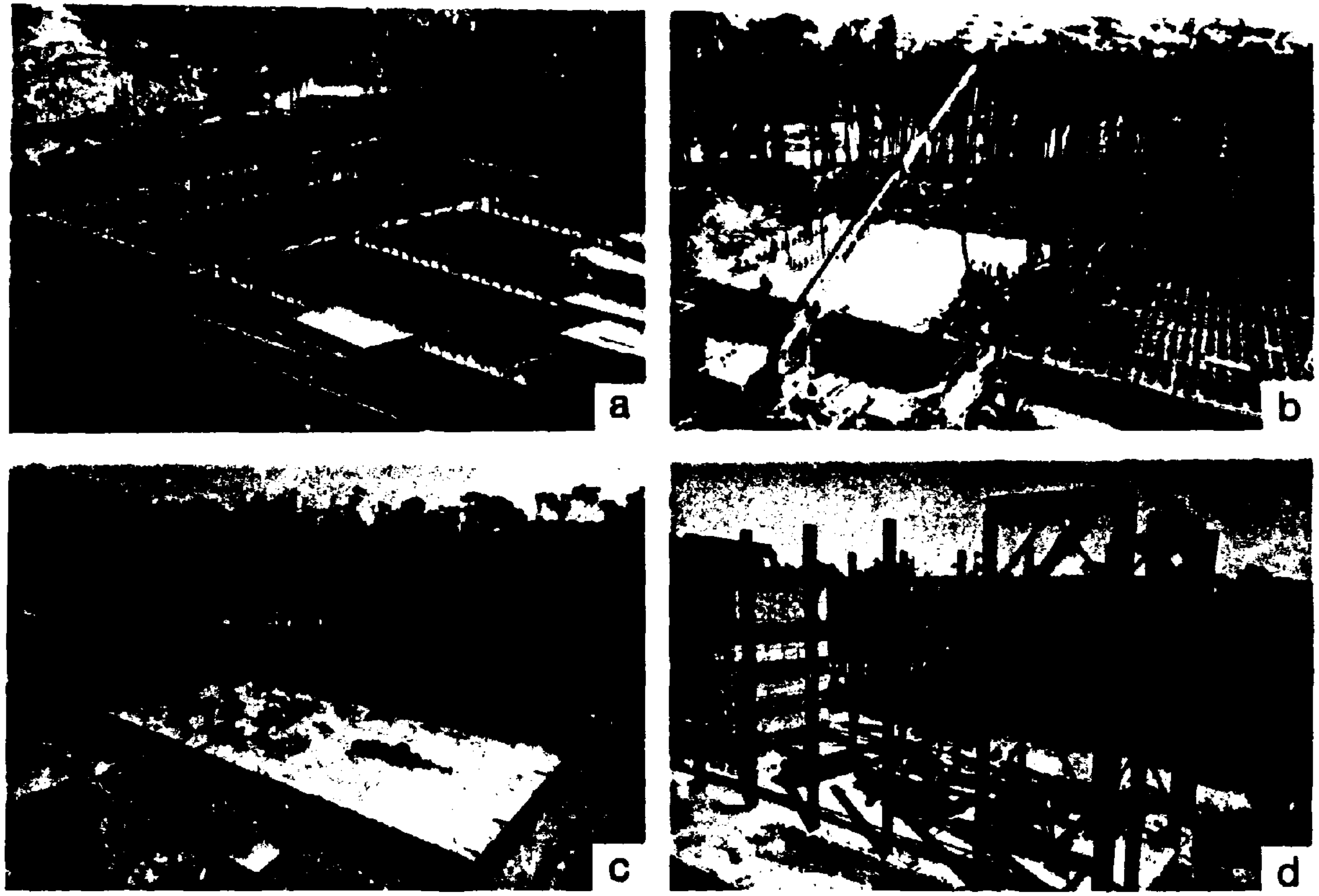


Fig. 3 Test Floor Construction Sequence Overview

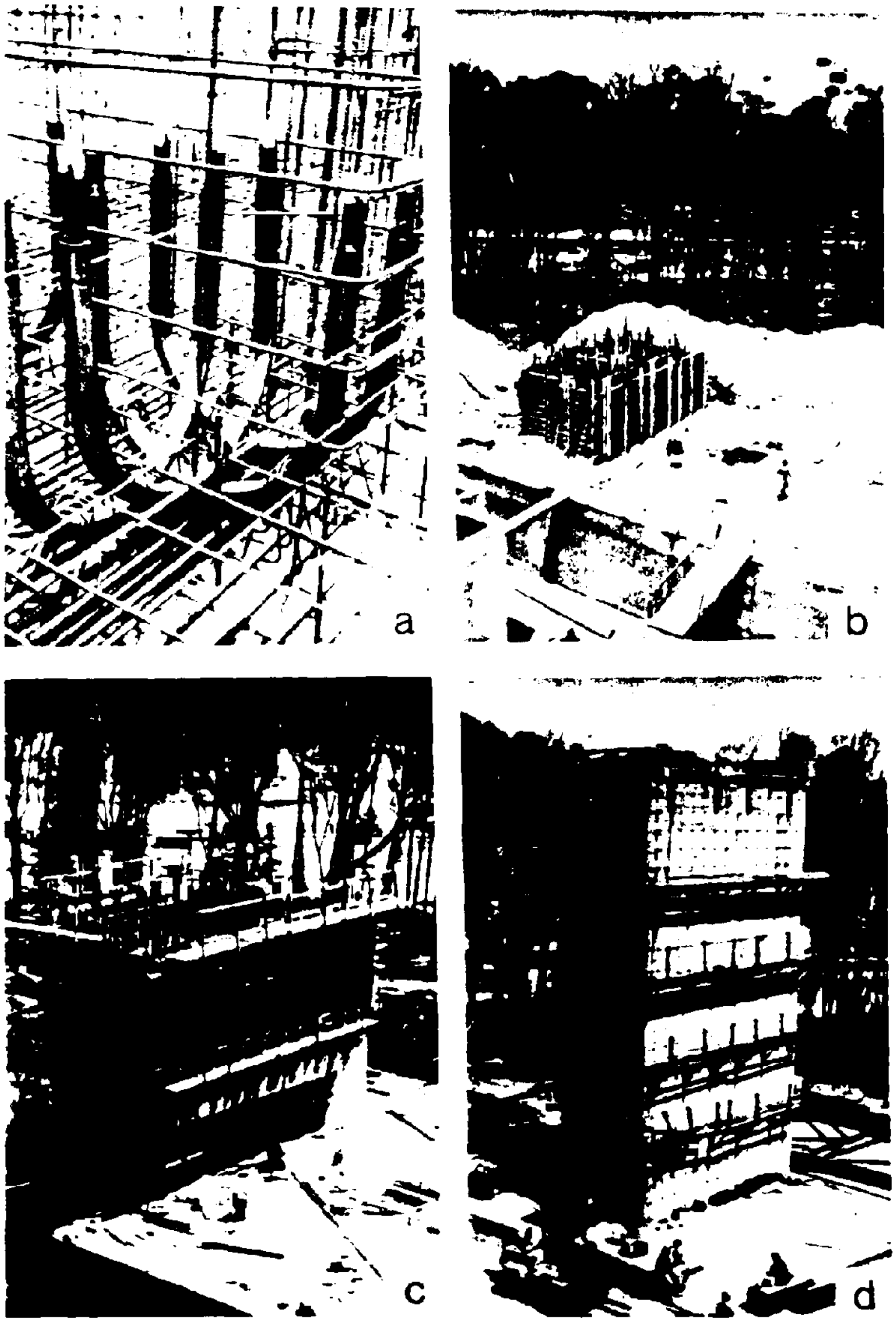


Fig. 4 Reaction Wall Construction Sequence Overview

2. FACILITY DESCRIPTION AND DESIGN CONCEPT

A large scale testing facility such as the UCSD Structural Systems Laboratory clearly poses special design consideration and requirements which will be discussed in this section.

In addition to obvious geometric and strength requirements for the construction and testing of five story full scale building systems, special attention has to be given to stiffness characteristics in order to provide satisfactory experimental boundary conditions.

2.1 Space Concept and General Requirements

The basic requirement for a high bay test facility which allows the experimental testing of five story or 50 ft (15 m) tall structural systems, the need for a minimum of ten ton overhead crane service, and the requirement of horizontal test floor space of over 100 ft (30 m) in length to test full scale bridge girders led to the box type geometry of the laboratory as shown in Fig. 5.

The plan views and cross sections in Figs. 6 and 7 depict some of the basic dimensions and geometry. The test floor plan in Fig. 6b shows the small annex which houses offices and utilities for laboratory staff as well as a data acquisition and computer room and small conference room for project meetings and discussions. Store front windows between annex and laboratory space allow the observation and/or control of tests from any annex room. Other essential support facilities for a structures laboratory of this size (such as work shops for wood and metals, machine shops, electronics shop, and a materials testing laboratory) are available in the adjacent engineering building. A fabrication yard 82x52.5 ft (25x16 m) with a structural reinforced concrete slab and 5000 pound (22 kN) tie down points on a 5 ft (1.5 m) module in two directions is located just to the south of the laboratory and allows the prefabrication and storage of test specimens and equipment.

The entire laboratory area can be serviced by a ten ton overhead crane (see Fig. 7) with double girder bridge and top riding hoist. Basement access for fork lifts and other machinery is provided at the east side of the laboratory by a 12.5% ramp (see Fig. 6). Truck access to the building is provided by a 24 x 30 ft (7 x 9 m) roll up door. A loading dock services the building on the west side.

The laboratory building consists of a four cell box girder test floor which is similar to existing structural testing facilities, e.g. [8, 9 and 10], a two cell post-

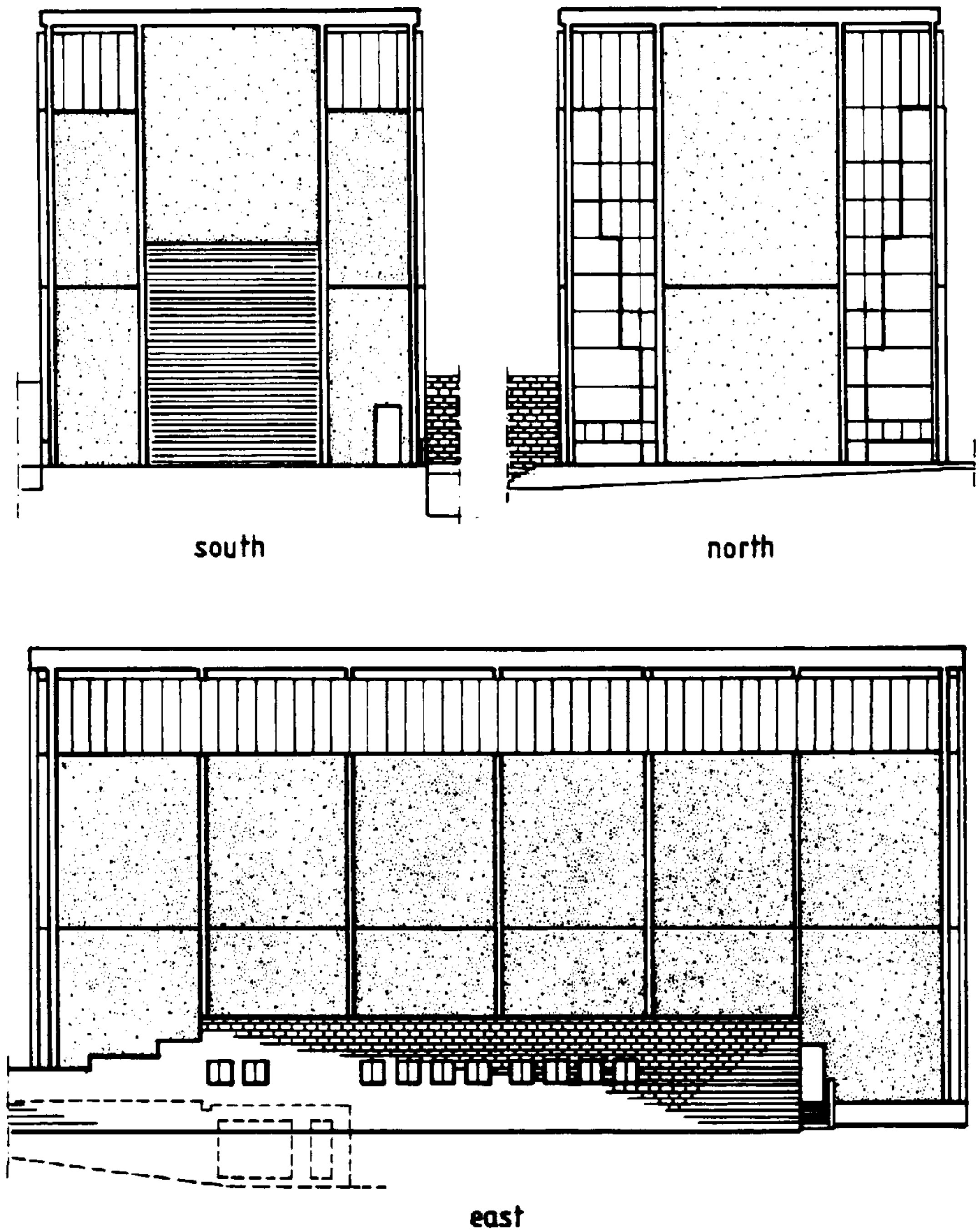
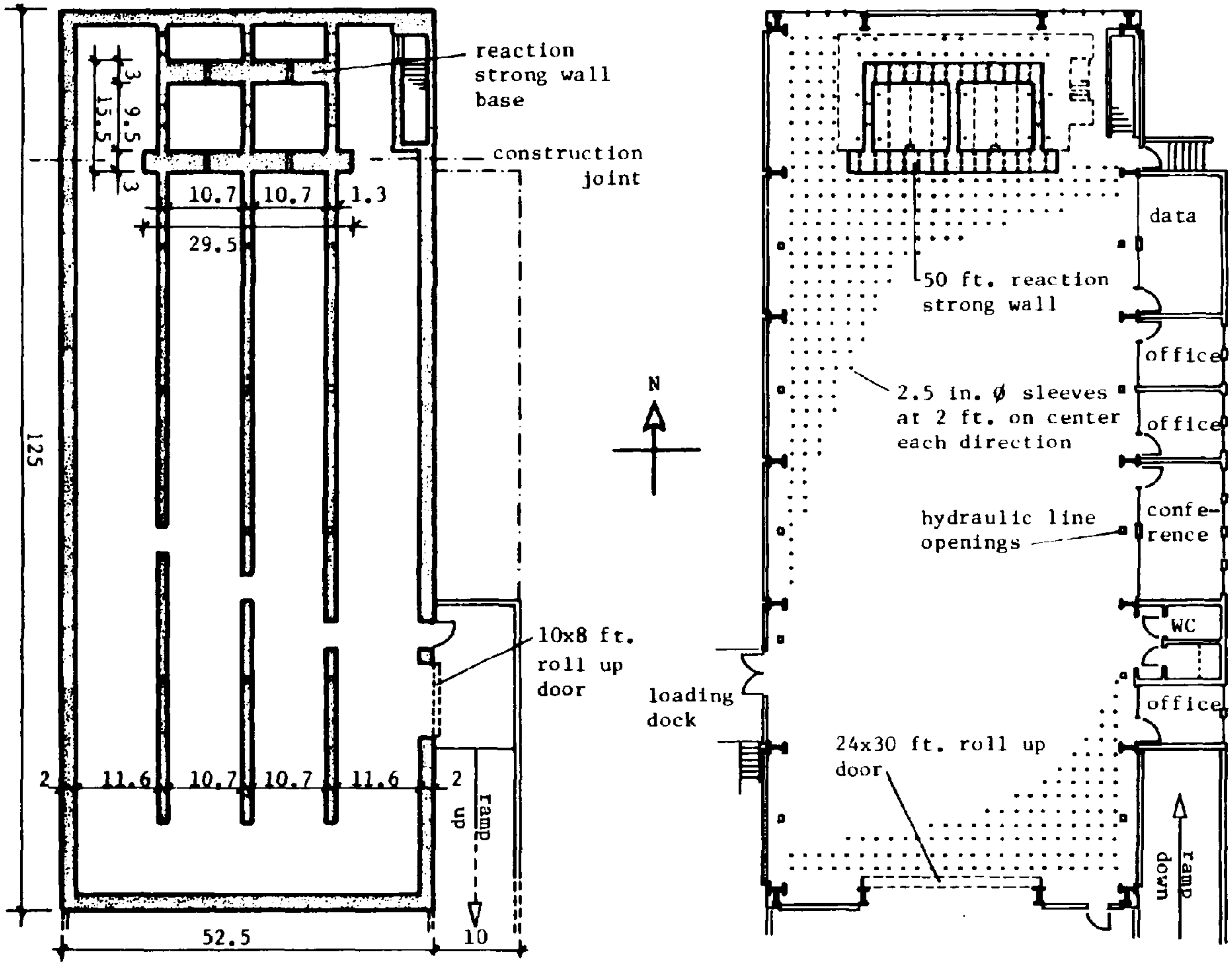


Fig. 5 Laboratory Elevations



a) basement dimensions in ft (1ft=.305m) **b) test floor**

Fig. 6 Laboratory Plan Views

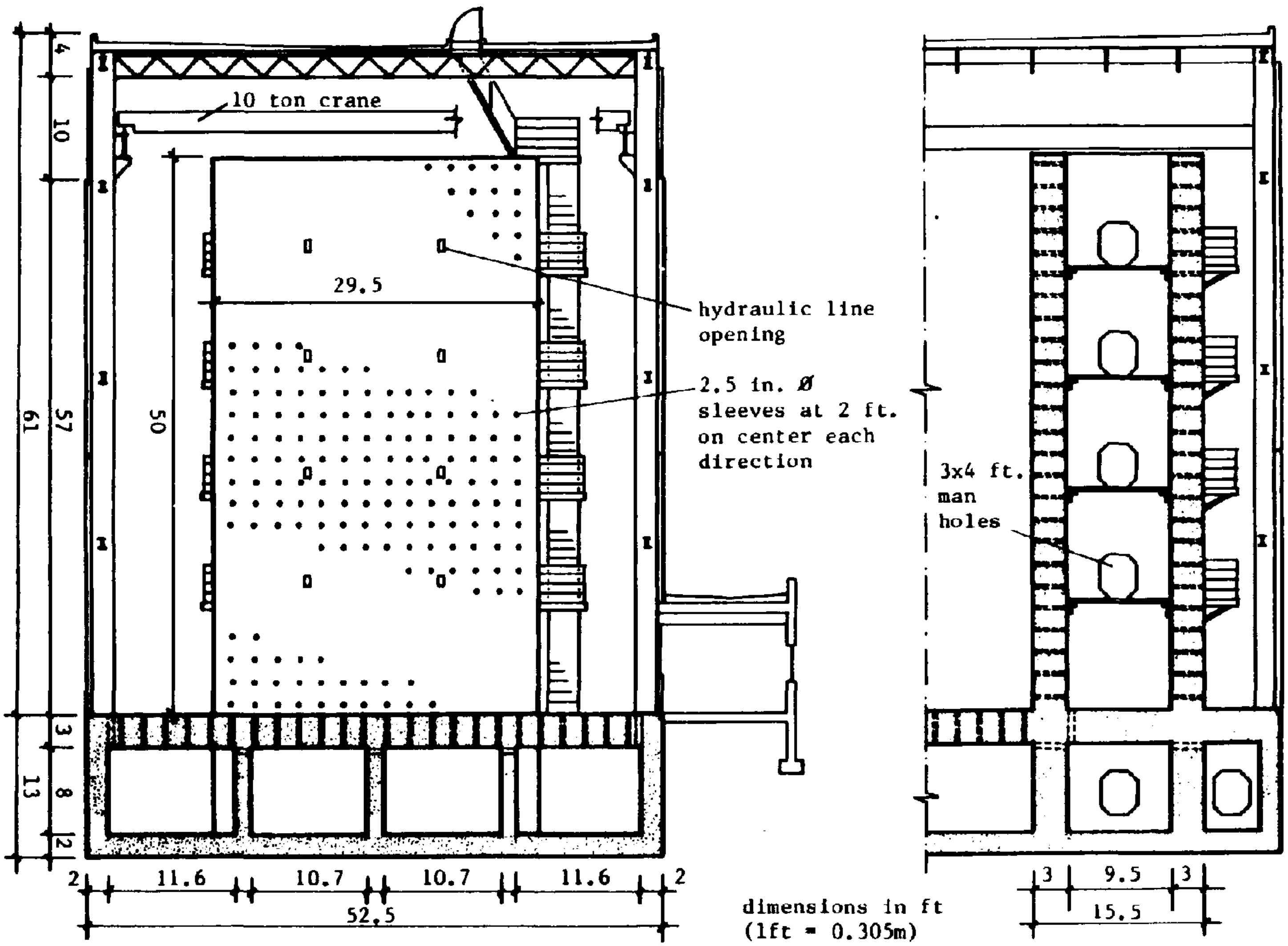


Fig. 7 Laboratory Cross Section

tensioned reaction strong wall and a structural steel and precast concrete enclosure. Natural lighting for the test area is provided by a continuous band of 10 ft (3 m) high aluminum framed windows along the top of the east and west faces of the building and over the entire height of the north wall on both sides of the buttress as shown in the elevations in Fig. 5. The outside building facade consists of precast concrete shear panels supported by a braced three dimensional structural steel frame. Reinforced concrete masonry is used for the single story annex.

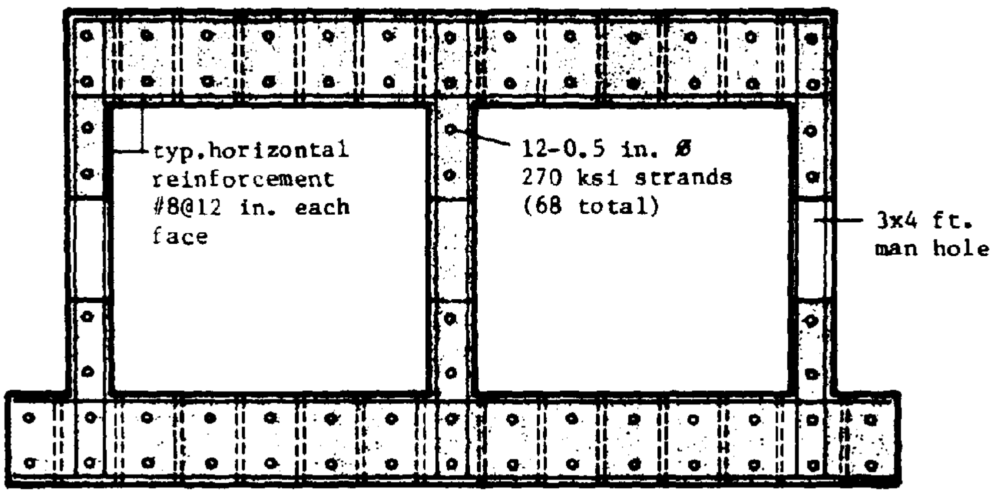
All structural concrete for the laboratory was specified with a nominal design strength of f'_c=5000 psi and grade 60 reinforcement. A maximum reinforcement spacing of 12 inches was specified for better crack control and preservation of structural stiffness integrity. Detailed geometric requirements for the test floor and the reaction strong wall are discussed in Sections 2.2 and 2.3, respectively.

2.2 Structural Test Floor

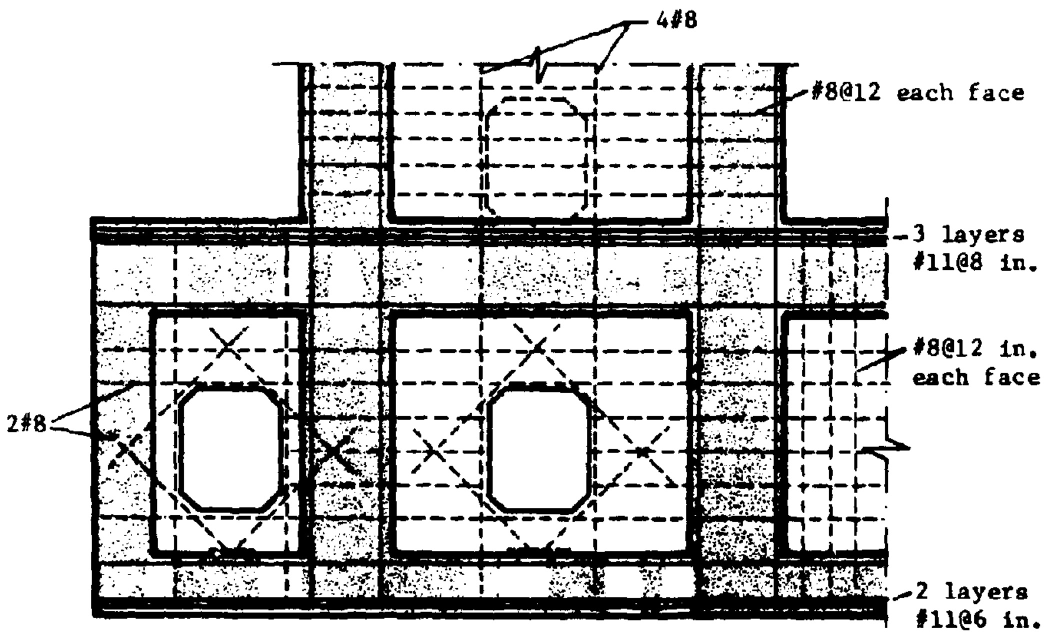
The reinforced concrete structural test floor is 125 ft (38 m) long, 52.5 ft (16 m) wide and 13 ft (4 m) deep. The top slab or test floor slab of the four cell box girder section is 3 ft (.9 m) thick and has 2.5 in. Ø (64 mm) tie down sleeves with cast iron screw caps on a 2 ft (0.6 m) module in the longitudinal and transverse direction. Detailed plan views of the basement and the test floor area are given in Fig. 6. The 8 ft (2.5 m) vertical clearance in the basement allows access for small forklifts which is required for equipment and hardware transport needed for the post-tensioning of test structures and load frames to the test floor.

While forklift access to each of the four box sections is from the south end, the three interior webs have walk through openings arranged on a diagonal (see Fig. 6a) necessitated by fire code regulations to shorten possible escape routes. The diagonal or offset arrangement was chosen to minimize possible concentrated shrinkage cracks across a weak zone in the box girder test floor.

The 3 ft (.9 m) test floor slab thickness was prescribed as a stiffness requirement to provide rigid boundary conditions for the test environment. The main reinforcement of the box girder test floor in the longitudinal direction consists of rebars in three layers of #11 @ 8 in. (Ø 35 mm @ 20 cm) at the top of the test floor slab and two layers of #11 @ 6 in. (Ø 35 mm @ 15 cm) at the bottom of the basement slab. The main reinforcement is continuous through the base of the reaction strong wall (see Fig. 8b) to pick up the cantilever moment from the reaction wall loads. Horizontal tie through holes at the base of the reaction wall in



a) typical cross-section



b) longitudinal section through base

Fig. 8 Reinforcement Layout

conjunction with vertical tie down points in the test floor slab can be used to apply external post-tensioning to the test floor slab in front of the reaction wall to minimize flexural cracks in the test floor slab under extreme loading conditions. Test floor reinforcement can be depicted from Fig. 8b and test floor capacities are discussed in Chapter 4.

The base of the reaction wall is monolithically tied into the box girder test floor as shown in Fig. 8 with standard 3x4 ft (0.9x1.2 m) manholes providing access to the compartments under and behind the reaction wall for structural inspection.

2.3 Reaction Strong Wall

The 50 ft (15 m) high and 29.5 ft (9 m) wide reaction strong wall is positioned at the north end of the laboratory and has a two cell box girder cross section. The front and back walls are 3 ft (.9 m) thick and provide horizontal 2.5 in. Ø (64 mm) sleeves on a 2 ft (0.6 m) module for the attachment of actuators or load frames. These tie through holes provide an option for horizontal post-tensioning of the reaction wall if the need for increased shear capacity arises. The detailed layout and dimensions of the reaction wall are shown in Figs. 6 and 7. Metal catwalks and 3x4 ft (0.9x1.2 m) manholes provide access to the reaction wall every 10 ft (3 m) level.

The entire reaction wall is heavily post-tensioned with 68 twelve strand (grade 270) tendons providing a uniform initial state of prestress of 850 psi (6 MN/m^2). The basic tendon layout is shown in Fig. 8a and the shear reinforcement for the webs in Fig. 8b.

The anchorage arrangement for the post-tensioning system is depicted in Fig. 9. The fixed end loop anchors are particularly advantageous for the vertical geometry since they can be permanently installed during the construction of the strong wall base and anchored to the bottom slab reinforcement without providing subsequent access for the stressing operation. The loop anchors are coupled to corrugated ducts for each of the reaction wall construction segments. With two vertical ducts connected by a loop anchor at the bottom, the corrosion and damage sensitive prestressing cables do not have to be installed until just prior to the post-tensioning operation at which time the tendons are fed through the duct, stressed from both ends simultaneously and subsequently grouted. For details on the post-tensioning procedure, see Section 3.3. The plan view of the loop anchorage layout which required the connection

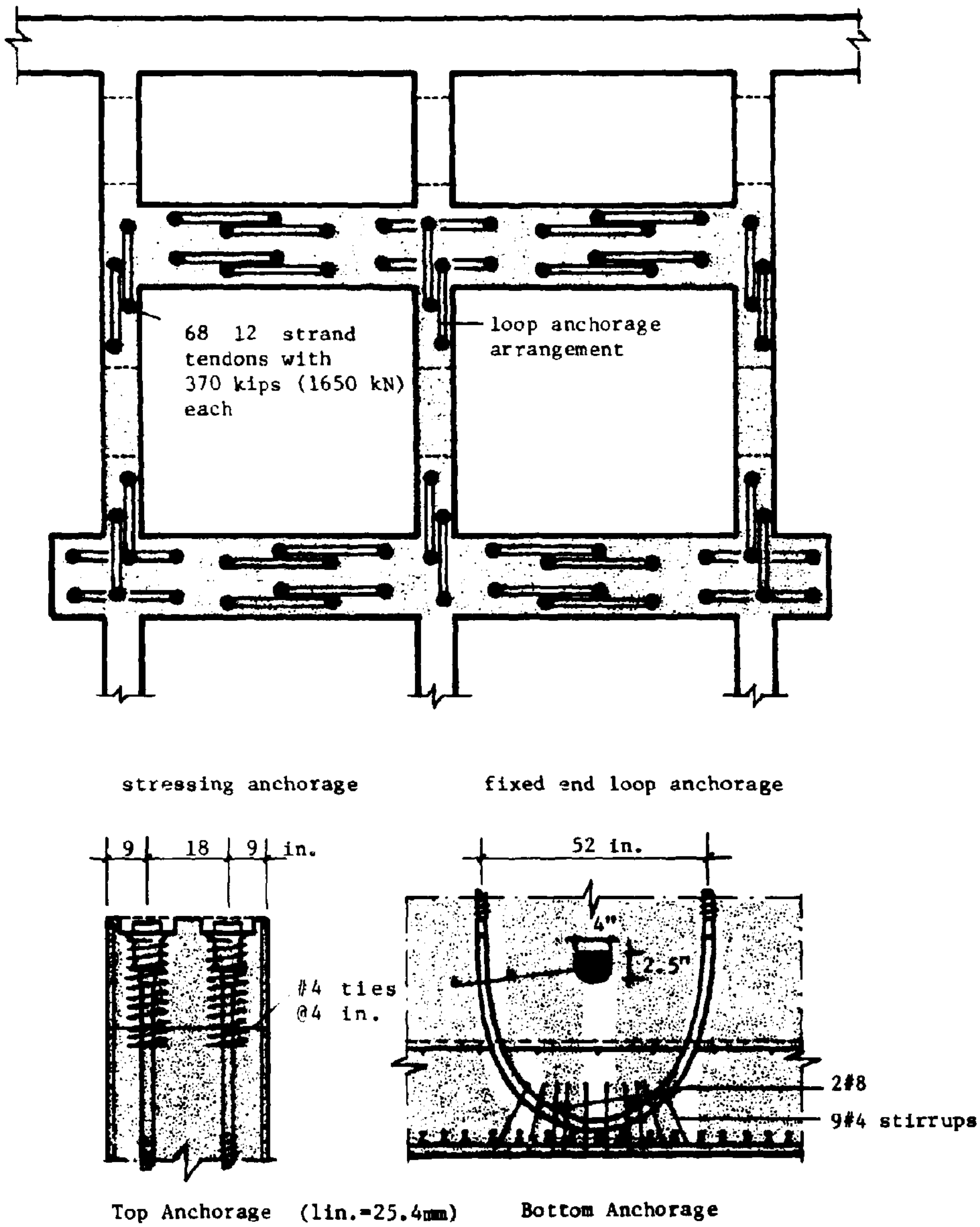


Fig. 9 Post-tensioning System and Achorage Details for Reaction Wall

of non-adjacent tendons due to a minimum bending diameter in the horseshoe shaped anchorage of 4.3 ft (1.3 m) is shown in Fig. 9.

The top stressing anchorages, also shown in Fig. 9, are arranged in plan as shown in the typical reaction wall cross section in Fig. 8a. The entire post-tensioning operation was designed to be conducted from the top of the reaction wall. Bond between the tendons and the reaction wall is established by pressure grouting of the ducts with cement mortar after the tendons are stressed. The ducts are grouted through vents at the bottom of the loop anchorages and continuous grouting along the height of the wall can be assured by an overflow of grout at the high point, i.e. the air vent at the top of the stressing anchorages.

2.4 Design Concept

The structural testing to be conducted in the UCSD Structural Systems Laboratory can range from full scale five story buildings loaded horizontally and vertically with a system of servo controlled hydraulic actuators (see schematic sketch in Fig. 2) to full scale overload and failure tests of bridge structures and components.

This wide range of special load and geometric arrangements as well as the nature of failure tests requires special design considerations over and above standard building code requirements. While load and strength requirements are still significant design factors, particular consideration has to be given to stiffness requirements in order to ensure satisfactory testing boundary conditions. This requires that deformations be kept to a minimum and cracks which are a direct cause for structural stiffness deterioration have to be eliminated or carefully controlled.

The stiffness objective was achieved by specified structural dimensions not necessarily derived from applied load requirements, by a finely spaced reinforcement mesh with 12 in. (30 cm) maximum spacing and by eliminating tensile stresses in the strong wall with full prestressing under general test loads.

The specific nature of the applied loads, generated with computer controlled hydraulic actuators and very accurately applied at predetermined locations, was the basis for a special limit state concept. Similar to the overload concept on bridge structures where heavier loads are only allowed with a special permit, required load capacities were separated in the design specifications into **Test Loads** (TL) and **Special Permit Test Loads** (SPTL). Test Loads (TL) are loads and load levels which can be applied without any additional verifications as static, cyclic or dynamic loads.

The deterministic nature of these loads and their point of application justifies a load factor of 1.4 for the ultimate strength limit state design.

Special Permit Test Loads (SPTL) are load levels for which a reduced ultimate strength limit state design load factor of 1.2 was specified reflecting the fact that these high load levels will be reached infrequently and for very specialized tests. At these high load levels the type of loading (static, dynamic, etc.), the geometry and the possible mode of failure of the test structure (i.e. shear failures with high and fast energy releases, etc.), and the redundancy in the load control and overload shut off system becomes very important so the "Special Permit" classification was affixed to these test loads requiring a special structural analysis documentation of the entire test and the anticipated structural response of the strong wall and the test floor, prior to any testing.

In terms of ultimate strength limit state load factors, the Test Loads and the Special Permit Test Loads are separated by a factor of 1.7 which translates to a load factor for tests loads of over 2.0 in areas where both Test Loads and Special Permit Test Loads are defined.

Design specifications asked for a Special Permit Test Load capacity of 135,000 ft-kip (185 MN-m) in flexure and 4,500 kip (20 MN) in base shear to be available in the reaction wall and box girder test floor. Maximum allowable tensile stresses were set at $6\sqrt{f'_c}$ under SPTL and full prestressing of the reaction wall was required for TL load levels.

The pertinent design criteria for the reaction wall can be summarized as follows:

Service Stress Limit State:

maximum allowable tensile stress in [psi]

0 for TL

$6\sqrt{f'_c}$ for SPTL

maximum allowable compressive stress in [psi]

$.45\ f'_c$ for both TL and SPTL

Ultimate Limit State Load Factors:

1.4 for TL

1.2 for SPTL

Concentrated point loads (TL) on the reaction wall assuming 6x6 in. (15x15 cm) minimum contact plates were set at 300 kip (0.7 MN) per anchor point with a possible repetition at 10 ft (3 m) in each direction. The same concentrated load requirements were applied to the test floor slab. No SPTL concentrated loads were specified since concentrated tie downs and load applications with individual hydraulic jacks and/or actuators will be part of the routine laboratory operations.

The usable TL and SPTL capacities of the reaction wall and test floor environment are substantiated in Chapter 4 and summarized in Fig. 22 for quick reference.

3. CONSTRUCTION OF THE UCSD LABORATORY

3.1 Construction Documentation

Construction on the UCSD Structural Systems Laboratory started in Spring 1985 and was completed with the dedication of the laboratory on May 4, 1986. Some of the official construction documents are shown in Appendix A.

The construction commenced with the excavation of the basement area and the placement of a 2 in. (5 cm) concrete waste slab. The outside forms for the exterior basement walls were positioned on the waste slab followed by the placement of the reinforcement for the 2 ft (60 cm) bottom slab and the vertical webs of the four cell box girder section. The loop anchors (see Fig. 4a) for the reaction wall post-tensioning system were tied into the bottom slab reinforcement and the 2 ft (60 cm) bottom slab was cast.

The vertical webs and the reaction wall base were formed and cast in two stages to allow reuse of some of the formwork (see construction joints in Fig. 6a). The first stage comprised the exterior walls on the east, south, and west face of the building as well as the interior web portions between the south end and the fire escape route openings (see Fig. 6a). The second stage consisted of the reaction wall base, the north basement wall and the interior webs in front of the reaction wall. Construction joints between the two stages in the exterior basement walls were reinforced with additional 6 ft (1.80 m) long #6 rebars @ 12 in. each face (Ø 19 mm @ 30 cm).

The formwork for the vertical walls was removed one day after casting the concrete and a sealant was sprayed on the green concrete surface for curing and surface treatment. Large shrinkage cracks in the vertical webs, particularly in the exterior walls within a two week period after casting of the concrete showed the inadequacy of the curing procedure. It was then decided that all future structural concrete work, in particular the test floor slab, was to be cured conventionally with a burlap cover and seven days moist curing. The completed base of the reaction wall and the completed webs of the four cell box girder test floor are shown in Fig. 3a.

Shoring of the test floor slab and placement of the heavy test floor reinforcement as shown in Fig. 10 followed. The 2-1/2 in. Ø (64 mm) tie down sleeves (see Fig. 11) were then inserted between the reinforcement mesh and positioned at the bottom by wooden blocks nailed to the framework prior to the placement of the reinforcement. At the top, the sleeves were set in place using a large template steel frame and welded to a mesh of #4 bars used exclusively for positioning purposes.

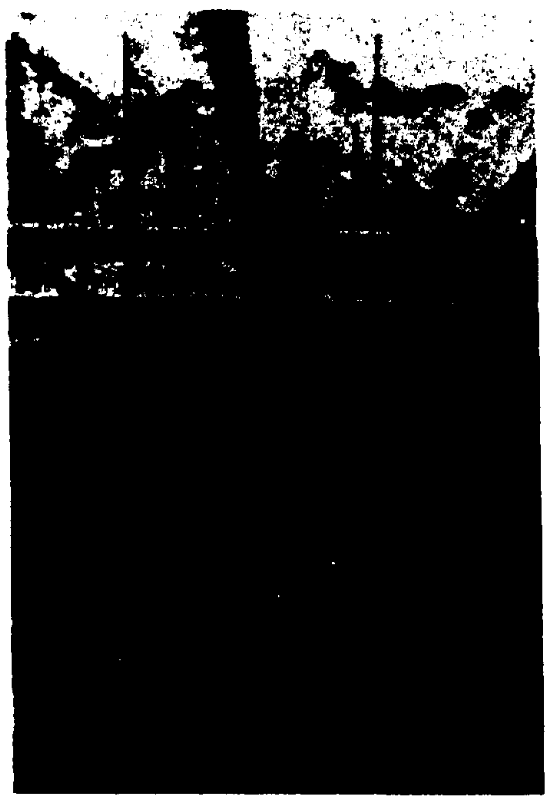


Fig. 10 Test Floor Reinforcement (longitudinal, 3 #11 @ 8 in. top, #8 @ 12" bottom; transverse, #8 @ 12" top and bottom)

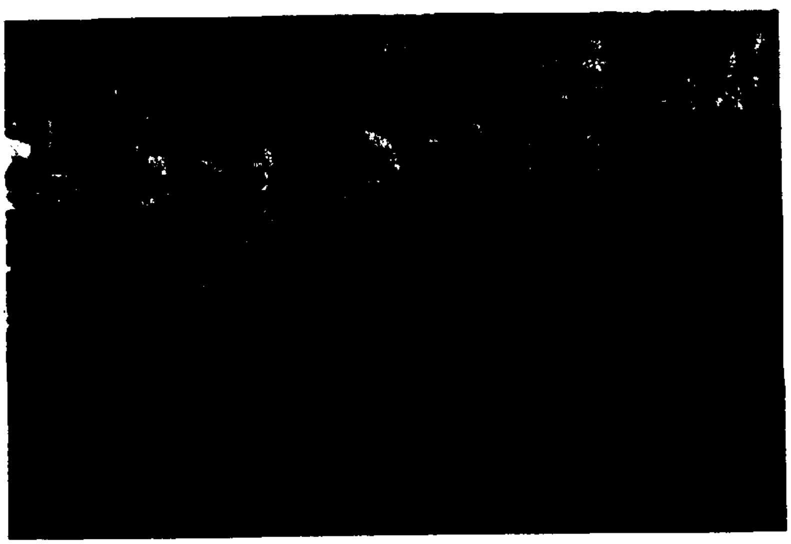


Fig. 11 Test Floor Tie-down Sleeves with Screw Caps (2-1/2" Ø sleeves on a 2 ft module in both directions)

The top of the tie down sleeves was fitted with a 3-1/4 in. (8 cm) threaded extension to allow the placement of cast iron screw caps and a level adjustment prior to the casting of the concrete. The 700 y^3 (540 m^3) of concrete for the test floor slab were cast continuously starting from north to south (see Fig. 3b) within a four hour time period. The tie down sleeves with the cast iron screw caps on a 2 ft (60 cm) module made the finishing process extremely difficult, which led in some areas to variances in test floor levels of over 1/2 in. (1.2 cm). It was debated and determined impractical to grind down these areas to the correct level, i.e. the screw cap level. Finally a decision was made to use screw caps with a longer thread portion which allowed the adjustment of the cap to the concrete level. Remaining voids between the screw caps and the test floor concrete were filled with epoxy mortar.

The reaction wall was formed and cast in 10 ft (3 m) segments as shown sequentially in Fig. 4. The formwork for the first 10 ft (3 m) lift, starting from the test floor slab, is shown in Fig. 12 together with the photo of a protected weldable strain gage placed 3 in. (8 cm) above the test floor level. Twelve of these gages are located around the inside and outside perimeter of the reaction wall to monitor strains at the reaction wall base (see also Fig. 21b). Location of these gages and strain data obtained during the construction, post-tensioning and post construction phase of the reaction strong wall are given in Section 3.3. Fig. 13 shows the reinforcement in the front face of the reaction wall and the 2.8 in. O/D rigid corrugated sheath for the post-tensioning tendons. All reinforcement bars in the reaction wall are #8 @ 12 in. (Ø 25 mm @ 30 cm) horizontal at each face and #6 @ 24 in. (Ø 19 mm @ 60 cm) vertical at each face.

Additionally, four #8 bars (Ø 25 mm) were placed vertically, six #8 bars horizontally, and two #8 bars diagonally under 45° around the access holes in the vertical webs.

The access hole was omitted in the center web for the first 10 ft (3 m) lift in order to ensure necessary base shear capacities. In the first 10 ft (3 m) lift the diagonal starter bars for the manholes in the exterior webs were inadvertently not placed in the test floor slab which necessitated some minor modification at that location. The first lift manholes were raised by 6 in. (15 cm) and a band of four #6 bars (Ø 19 mm) was placed horizontally in the 6 in. (15 cm) concrete step to provide a horizontal shear tie.

The construction joint between individual lifts was scarified with 1 in. (2.5 cm) shear keys in the webs and front and back walls to establish mechanical interlock.

Fig. 12 Construction and Instrumentation of First 10 ft Lift of Reaction Wall

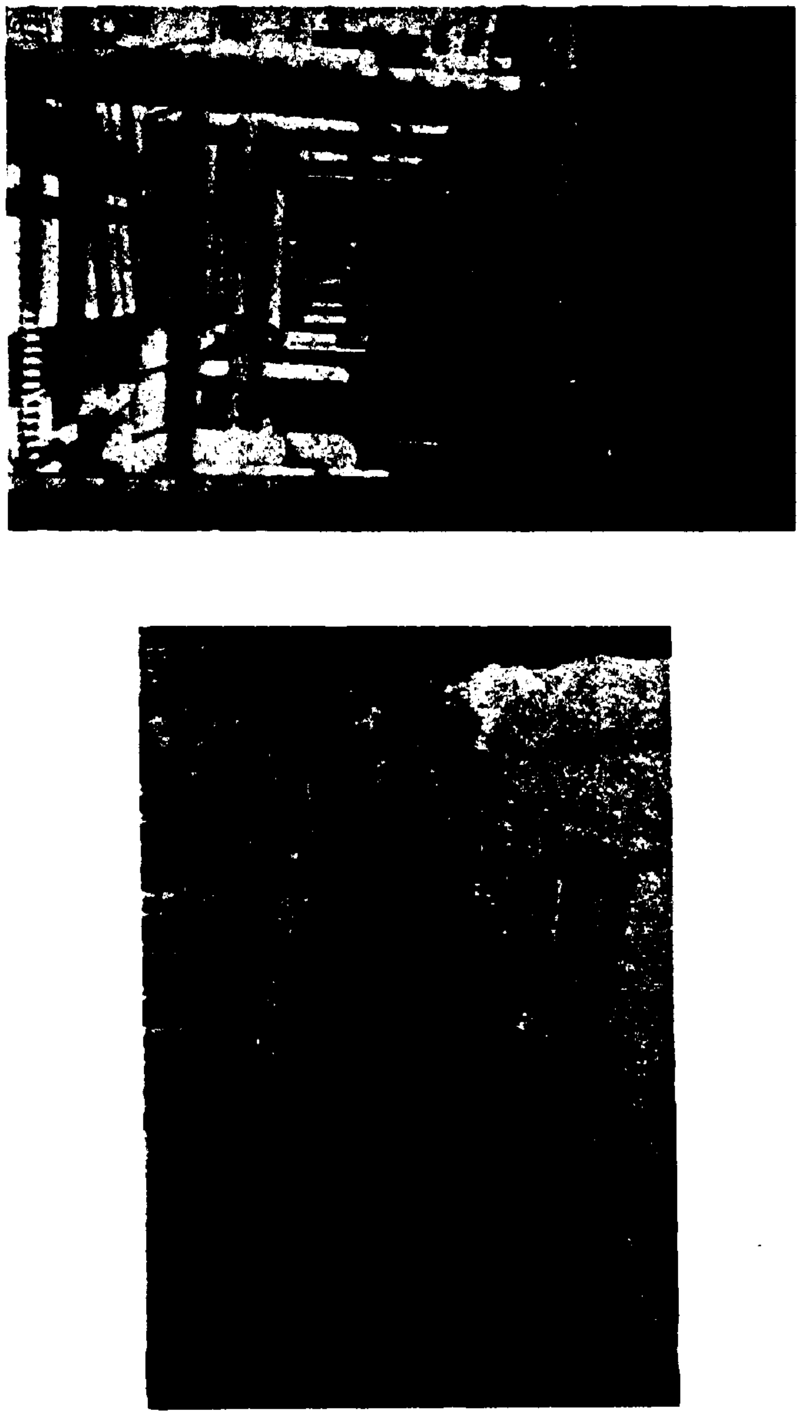


Fig. 13 Reaction Wall Reinforcement and Ducts for Post-tensioning Tendons

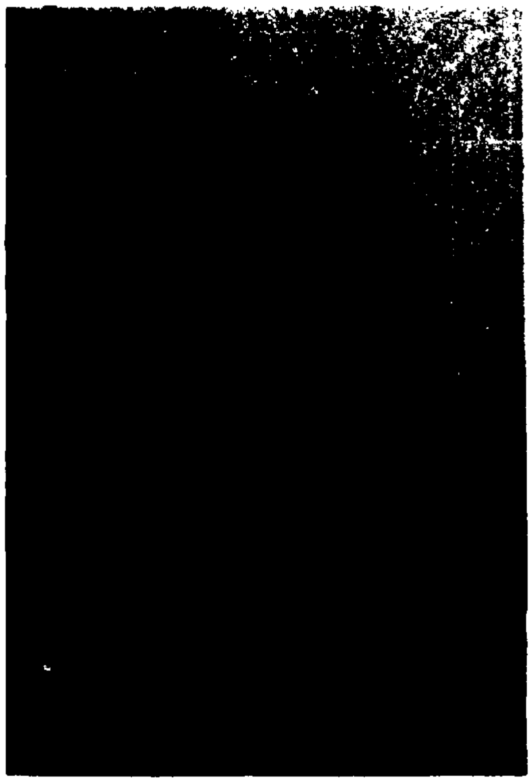
These shear keys, in addition to the vertical reinforcement and the uniform initial state of prestress of about 850 psi, will ensure monolythic behavior.

In Fig. 14, the final stage of construction, i.e. the fifth 10 ft (3 m) lift is shown together with the splitting reinforcement spirals for the top stressing anchorages (see also Fig. 9). The completed reaction wall can be seen in Figs. 3c and 4d prior to the post-tensioning operations. The bell anchor heads are shown prior to placement at the top of Fig. 15 and the actual stressing operation which will be discussed in detail in Section 3.3 is shown at the bottom of Fig. 15.

Prior to the post-tensioning, the twelve strand tendons had to be threaded through the vertical ducts in the reaction wall. The biggest problem was the installation of a pull cable which was finally accomplished by blowing a nylon string tied to an air filled ziplock plastic bag through the duct by means of a commercial vacuum blower. The nylon string was used to place a pull rope and the pull rope to place a 1/2" Ø (12 mm) steel cable. The steel cable was then attached to the twelve strand tendon by means of a pull sock and shackle as shown on the top of Fig. 16. The bottom of Fig. 16 shows one of the problems encountered when two of 34 cables were jammed in the ducts during the pulling operation. The steel rope was pulled off the pull sock and a trial to pull back the tendon in the reverse direction jammed the pull sock in the partially blocked corrugated duct. The problem was resolved by exactly locating the jammed position within the duct with wire probes from both ends and by subsequently opening the reaction wall with an 8 in. high and 3 in. wide slot (20 cm x 8 cm) to free the damaged pull sock. After successful placement of the two problem tendons (see Section 3.3, Fig. 21 for location) the openings which were located in the basement and at the 12 ft level were dry packed with a combination of epoxy mortar and pea gravel which reached nominal compressive strengths of f'_c = 8,810 psi (60 MN/m^2) and a 60 day value of 8,900 psi (61 MN/m^2), respectively, which is significantly stronger than the reaction wall concrete (see Section 3.2, Concrete Properties).

After the placement of the tendons, 2 in. (5 cm) thick anchor plates with conical holes were slipped over the tendon ends and conical wedge grips were positioned around each tendon in the anchor plate hole (see Fig. 15). The wedges were manually preset prior to the stressing operations.

Simultaneously to the post-tensioning of the reaction wall, the structural steel frame consisting of structural shapes W 24x68 vertical (see layout in Fig. 6b) and W 10x22 horizontal was erected with lateral bracing at the north and



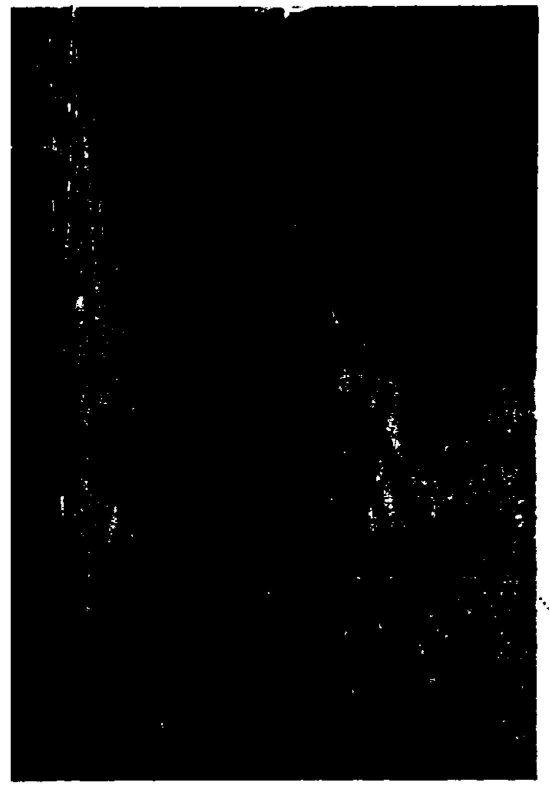


Fig. 14 Final 10 ft Lift of Reaction Wall with Spiral Reinforcement for Tendon Anchorages

Fig. 15   Anchor Heads and Post-tensioning Operations

Fig. 16 Pull Sock for 12 Strand Tendon and Rescue Operation

south face in the first 20 ft (6 m) bay of the east and west face starting from the south end. The built up roofing consisted of light weight concrete on metal decking, supported by light steel truss joists, 6 ft - 8 in. (2m) on center.

The outside facade consisted of precast concrete tilt up panels, 6 in. (15 cm) thick with built in anchor plates, cast horizontally on top of each other. The panels were welded at the anchor plates to the outside flange of the structural steel columns and vertical and horizontal joints were caulked.

On the south side of the laboratory a 5000 ft^2 (465 m^2) structural concrete slab was placed to provide a fabrication area for test specimens. The 6 in. (15 cm) slab was reinforced with #4 @ 6 in. (Ø 13 mm @ 15 cm) rebar in two directions at the center of the slab. Tie down points with 5000 lbs (22 kN) capacity were placed on a 5 ft (1.5 m) module over the entire slab area to allow stabilization of test specimens such as wall panels etc., by means of guy wires. The anchor point detail and the casting of the fabrication yard slab are shown in Fig. 17.

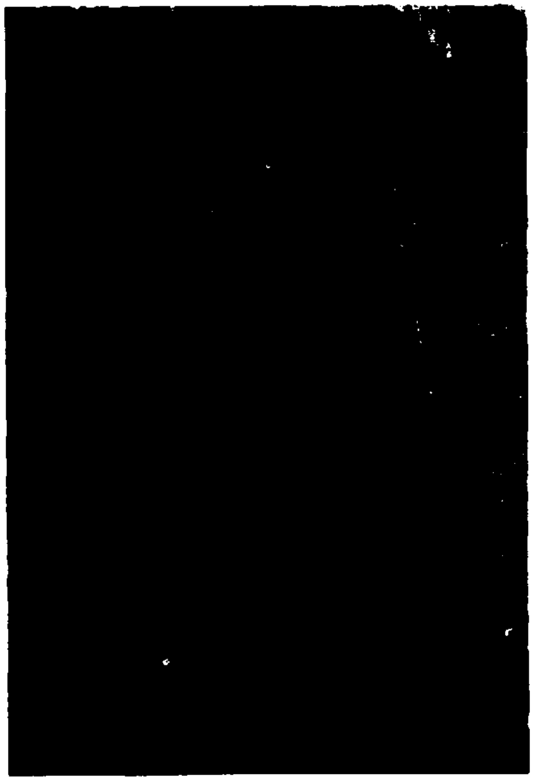
The reaction wall was then outfitted with steel catwalks at every 10 ft (3 m) level to provide access for post-tensioning operations, instrumentation and hydraulic power supply to actuators positioned at any location of the reaction wall face.

The completed Structural Systems Laboratory is shown in Fig. 18-20. The interior of the laboratory and various angles of the reaction wall are presented in Fig. 18 and 19, while the outside appearance of the completed laboratory is depicted in Fig. 20 with photos of the southeast (top) and northwest (bottom) laboratory faces.

3.2 Concrete Quality Control

The specified nominal strength of f_c'=5000 psi (35 MP) for all structural concrete was monitored by standard ASTM cylinder tests at 7 and 28 days as well as additional tests at 14 and 60 days, where required. The results of these tests are summarized in Table 1 together with casting dates of the various structural concrete construction segments.

From Table 1 it is apparent that the required nominal 28 day strength was difficult to achieve which is primarily a function of the "soft" aggregates naturally available in the San Diego area.



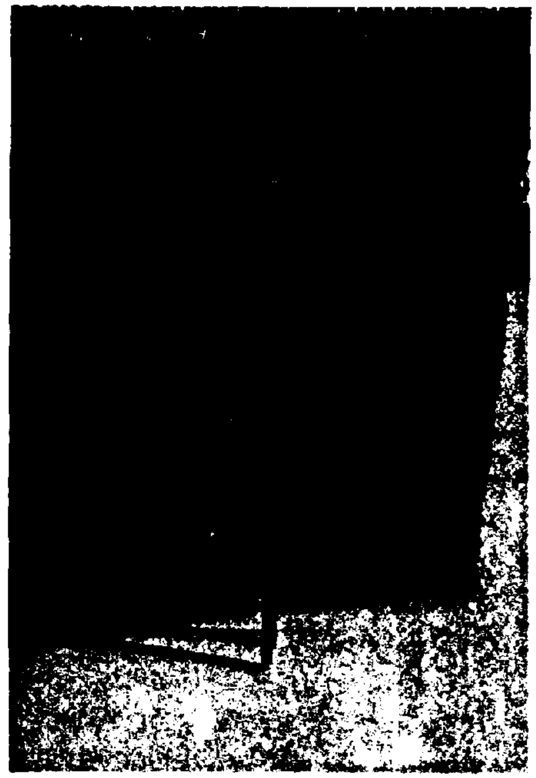


Fig. 17   Fabrication Yard Slab (6" RC slab with tie-down points of 5000 lbs capacity on a 5 ft module as shown)

Fig. 18 Completed Laboratory and Reaction Wall

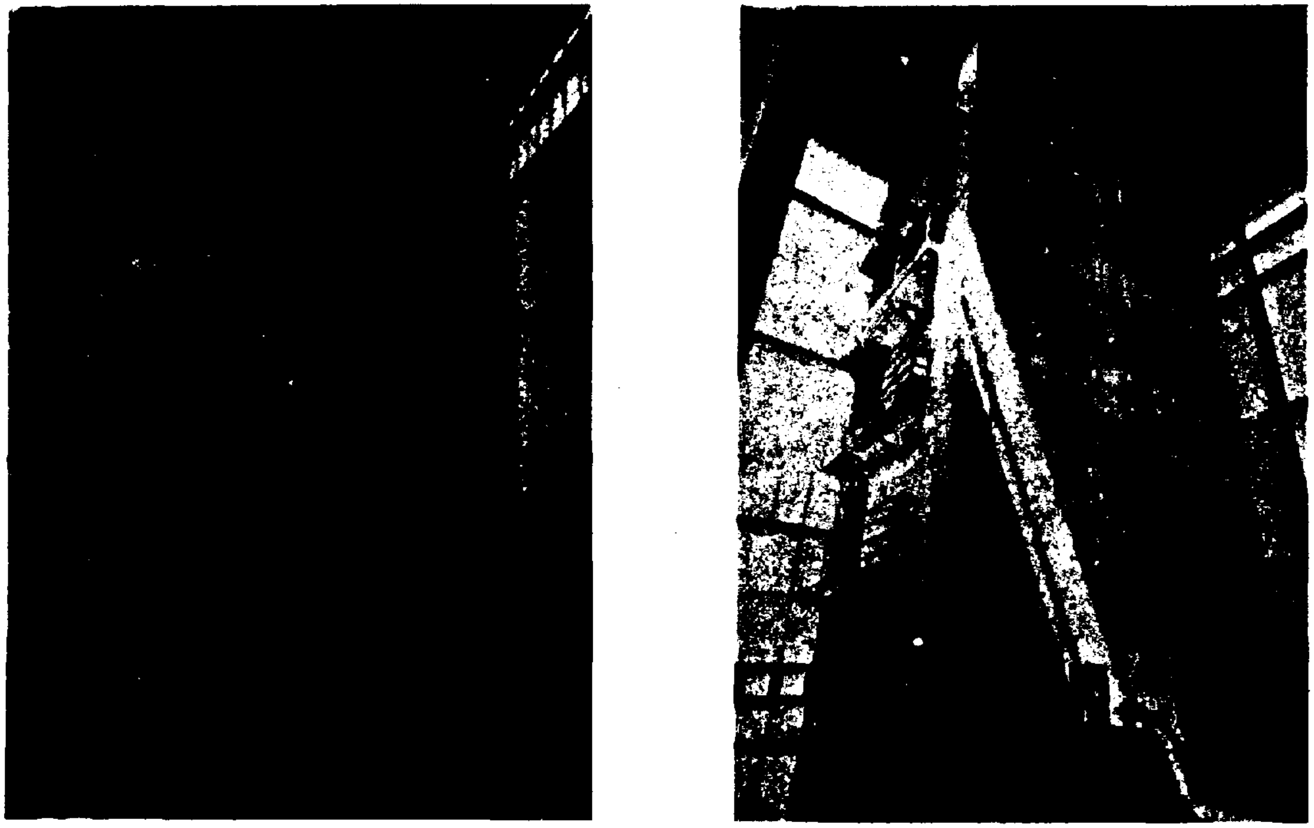


Fig. 19 Different Perspectives of Reaction Wall

Fig. 20   Outside Appearance of Completed Laboratory

Table 1: Concrete Cylinder Tests - Structures Laboratory
Required: f'_c = 5000 psi at 28 days

Date of Casting	Area \ Days		7	14	28	60
5/22	Basement Slab	North	2780	----	4100	4620
			3330	----	5020	5450
		South	3150	----	4350	5020
6/13	Basement Walls	South	4120	----	5660	----
6/26	Basement Walls (Reaction Wall Base)	North	3710	----	3430	5700
7/26	Test Floor Slab	North	4030	4790	6100	----
			4580	5310	5660	----
			4390	5180	5360	----
		South	3540	4530	5060	----
8/3	Reaction Wall	0'-10'	4490	4670	5770	----
8/13	Reaction Wall	10'-20'	1900	----	3700	5040
8/19	Reaction Wall	20'-30'	3710	----	5220	----
8/26	Reaction Wall	30'-40'	3360	3800	4070	----
9/6	Reaction Wall	40'-45'	3860	4320	5550	----
		45'-50'	4100	----	5480	----

The 2 ft (60 m) basement bottom slab showed 28 day values as low at 80% of specified. Subsequent 60 day tests showed the specified design strength was almost reached.

The vertical webs of the box girder test floor and the basement walls showed seven day test values very close to the expected values. The 28 day tests however, showed for the reaction wall base vicinity a value even lower than the corresponding seven day strength which points towards improper handling of the test cylinder, particularly with the corresponding 60 day test showing the expected high level of 5700 (40 MPa).

The best consistency in concrete quality was reached in the 3 ft (.9 m) test floor slab where all 28 day tests reached the required strength level.

In the reaction wall, the second and fourth lift indicated some lower strength concrete already at the 7 day test which was confirmed with 28 day tests well below the required design strength. However, corresponding 60 day tests showed the nominal design strength was reached even though not in the required time period.

No materials tests were performed on the Grade 60 rebars or on the Grade 270 prestressing steel.

3.3 Reaction Wall Post-Tensioning and Strain Data

The post-tensioning of the reaction wall was accomplished by means of 68 12-strand tendons arranged in plan as shown in Fig. 8a. Always two of these vertical tendons were combined and connected by a loop anchor as shown in Figs. 9 and 4a. The two ends of each of the tendons were stressed simultaneously from the top to minimize friction losses in the ducts. In the following, the post-tensioning procedure, the associated strain data and the time-dependent strain data after the post-tensioning operation are discussed.

The reaction wall was post-tensioned using the VSL E 5-12 units prestressed with an initial jack force of P_i = 370 kip/tendon (1.65 MN) which corresponds to a jacking stress of $f_{p,i}$ = 202 ksi (14 MPa) or 0.75 f_{pu}. Assuming an anchor set of Δl_a = 0.165 in. (4.2 mm) as provided by the manufacturer and an elastic shortening in the 50 ft (15 m) wall of $\Delta l_{el} = PL/AE_c$ = 0.2 in. the average transfer prestress loss after stressing of all tendons is

$$\Delta f_{p,t} = (\Delta l_a + 0.5 \ \Delta l_{e;}) \frac{E_p}{L} = 12.4 \text{ ksi (85 kPa)}$$

With the tendon placed vertically in a straight rigid duct, no curvature friction and very little wobble friction (derived for horizontal tendon and duct layout) has to be accounted for. Assuming a wobble coefficient $K = 0.0002$, the stress reduction factor at $L = 50$ ft (15 m) is $e^{-0.0002 \times 50} = 0.99$ and with it the maximum prestress after transfer of

$$f_{p,o} = 0.99\ (f_{p,i} - \Delta f_{p,t}) = 188 \text{ ksi (1.3 MPa) or } 0.7\ f_{pu}$$

Assuming furthermore, a time-dependent loss of prestress of 15 ksi (0.1 MPa), the average prestress at $t = \infty$ is

$$f_{p,\infty} = f_{p,o}\ \left(\frac{1 + 0.99}{2}\right) - 15 = 172 \text{ ksi (1.2 MPa)}$$

in the prestressing steel.

This results in an average prestress force at $t = \infty$ of

$$P_\infty = f_{p,\infty}\ A_p\ n = 172 \times 183 \times 68 = 21{,}500 \text{ kip (95 MN)}$$

or an average prestress in the concrete of

$$f_{c,\infty} = 740 \text{ psi (5.1 kPa)}$$

A more detailed analysis of time-dependent effects can be carried out taking casting dates in Table 1 and stressing dates in Table 2 into account.

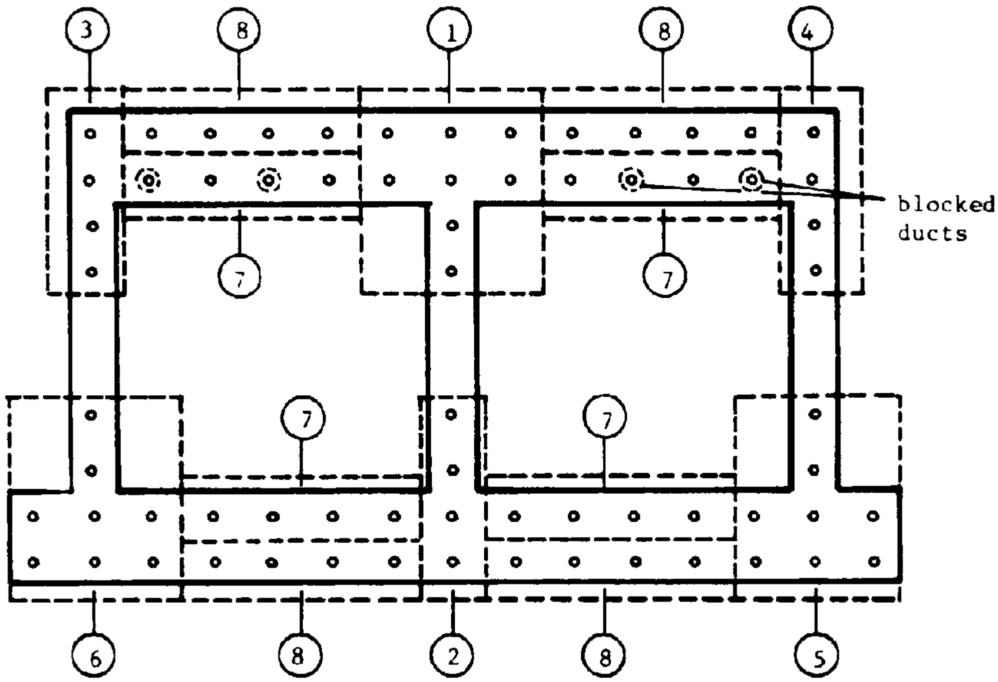
Stress levels in the tendons were monitored by means of a calibrated pressure gage on the hydraulic pump and checked against a total tendon elongation of 5-1/4 in. (13 cm).

The stressing of the tendons followed the stressing sequence outlined in Fig. 21a.

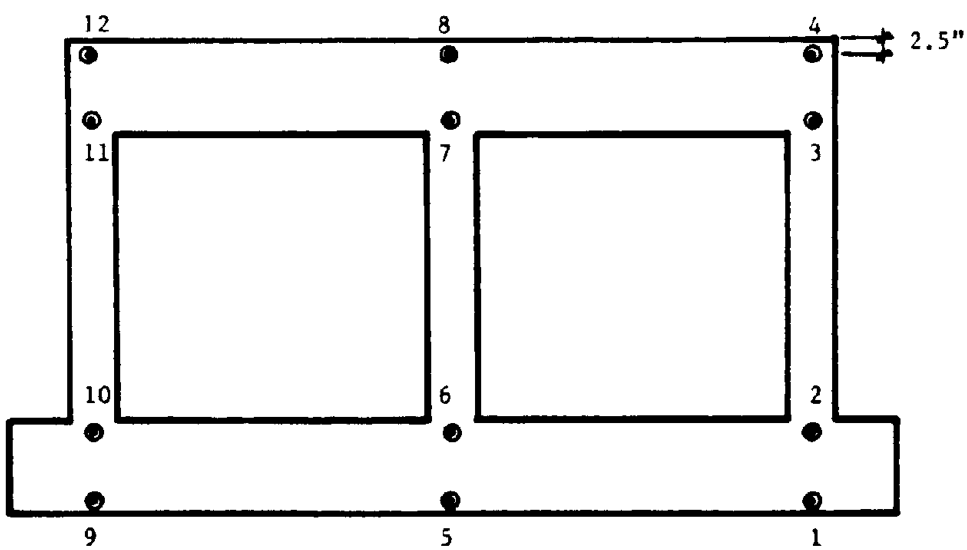
As mentioned in Section 3.1 and shown in Fig. 12, weldable 1 in. (2.5 cm) long strain gages were placed at the strong wall base to monitor the strain history. The exact location of the 12 gages is shown in 21b.

Strain values obtained during the post-tensioning operation are given in Table 2 as measured after each of the sequential post-tensioning areas shown in Fig. 21a. Table 2 also shows the post-tensioning dates for a more detailed time-dependent effect analysis of the reaction wall stress state.

It should be noted that all gages had to be read manually using battery operated strain boxes. Repeatability



a) prestressing sequence



b) gage location and numbering

Fig. 21 Post-tensioning and Instrumentation of Reaction Wall of readings with the instruments used was only within ± 30 μ strains and drift between measurements cannot be accounted for.

As seen from Table 2, two of the gages, #2 and #5, were outside the balancing range of the strain box. These two gages were checked and are still stable and can be used in future load tests on the reaction wall with the addition of appropriate resistors.

The strain values shown in Table 2 are given in micro-strains (10^{-6}) and represent relative strain values with respect to a strain reading taken just prior to the commencement of the prestressing operation. No attempt will be made here to explain the strain values shown in Table 2 and any interpretation should keep the problems with the strain measurements and the uncontrolled environment (temperature difference from direct sunlight on different faces of the reaction wall at different times of the day) in mind.

The same twelve gages were also monitored on a regular basis after the post-tensioning of the reaction wall in order to obtain time-dependent strain data and possible answers on prestress losses in the reaction wall.

The absolute strains as measured before and after the post-tensioning are presented in Table 3. The shown absolute strain values indicate again the problems with the manual data acquisition and should be interpreted very carefully.

Table 2: Relative Strain Measurements in Reaction Wall During Prestressing Operation (strain x 10^{-6})

Date	10/1	10/2	10/3	10/7	10/21	10/24
Gage						
# 1	-8	-42	-258	-352	-386	-398
2	-	-	-	-	-	-
3	-38	-142	-162	-200	-210	-220
4	-132	-276	-272	-354	-360	-404
5	-	-	-	-	-	-
6	-16	-28	-60	-94	-104	-106
7	-108	-124	-132	-212	-234	-266
8	-100	-152	-116	-238	-264	-264
9	2	-46	-280	-340	-354	-352
10	-4	-52	-172	-224	-258	-254
11	-48	-118	-138	-212	-228	-228
12	-78	-182	-218	-312	-344	-366
Comment	Area 1 Stressed	Areas 1-4 Stressed	Areas 1-6 Stressed	Areas 1-8 Stressed Except Tendons Marked ◎		All Tendons Stressed

Table 3: Time-Dependent Absolute Strain Data in Reaction Wall Base after Post-Tensioning

Date	* 9/30	10/24	11/4	11/26	12/11	1/14	2/11	3/11	4/17
Gage									
#1	102	-296	-290	-312	-270	-260	-304	-295	-340
#2	-	-	-	-	-	-	-	-	-
#3	38	-182	-148	-166	-120	-146	-226	-170	-230
#4	72	-332	-315	-380	-344	-364	-428	-398	-432
#5	-	-	-	-	-	-	-	-	-
#6	6	-100	-110	-146	-100	-100	-142	-118	-146
#7	-2	-268	-250	-260	-264	-234	-222	-210	-238
#8	-30	-296	-349	-296	-240	-254	-280	-230	-264
#9	40	-312	-309	-300	-228	-206	-270	-266	-300
#10	20	-234	-254	-262	-206	-188	-246	-246	-276
#11	48	-180	-191	-232	-196	-146	-264	-210	-248
#12	68	-298	-308	-346	-276	-280	-370	-332	-382

*Reference Value Prior to Post-tensioning

4. CAPACITIES AND CHARACTERISTICS

Based on design guidelines and formulas for reinforced and prestressed concrete structures as presented in ACI 318-83 [11], the following limit states can be derived for the reaction wall and the box girder test floor.

Information on the basic dynamic characteristics and critical stress states in the reaction wall are also provided.

4.1 Test Floor Limit States

The transverse flexural behavior of the 3 ft (0.9 m) thick test floor with rebars #8 @ 12 in. (Ø 25 mm @ 30 cm) top and bottom, cc = 1 in. (2.5 cm), has a nominal ultimate limit state of M_n = 130 ft-kip (175 kN-m) for an assumed cracked section with

$$M_u = \Phi M_n = \psi M_{max}$$

where M_{max} = 0.26 P for a 6 in. x 6 in. (15 x 15 cm) concentrated load distribution area (see [12]). The maximum Test Load as defined in Section 2 with a load factor of 1.4 is then

$$P_{max} = \frac{1}{0.26} \frac{\Phi}{\psi} M_n = \frac{1}{0.26} \frac{0.9}{1.4} 130 = 320 \text{ kip } (1.4 \text{ MN})$$

Repetitive maximum concentrated loads P = 300 kip (1.3 MN) should not be spaced closer than the web spacing in both directions, i.e. approximately 10 ft (3 m). If concentrated loads smaller than P_{max} = 300 kip (1.3 MN) are present, the maximum spacing can be reduced accordingly.

The longitudinal flexural capacity of the four cell box girder test floor has to match or exceed the requested Special Permit Test Load capacity of 135,000 ft-kip (180 MN-m) of the reaction wall.

With an effective depth of 145 in. (3.7 m) to the three layers of #11 bars @ 8" (Ø 35 mm @ 20 cm) over an effective width for the three center webs of 36 ft (11 m), the nominal moment capacity is

$$M_n = A_s f_y \left(d - 0.59 \frac{A_s f_y}{b f'_c}\right) = 180,000 \text{ ft-kip}$$

or

$$M_{max} = \frac{0.9}{1.2} Mn = 135,000 \text{ ft-kip } (180 \text{ MN-m})$$

The interior web reinforced with #8 bars @ 12" (Ø 25 mm @ 30 cm) on each face have an ultimate shear limit state of

$$V_n = V_s + V_c = A_v f_y d/s + 2\sqrt{f'_c}\, b_w d$$

$$= 11,146 + 328 = 1,500 \text{ kip/web}$$

or

$$V_{max} = \frac{0.85}{1.2} V_n = 1,000 \text{ kip/web (4.5 MN/web)}$$

for 30 ft (9 m) in front of the reaction strong wall.

4.2 Reaction Wall Limit States

The reaction wall was designed according to the specifications in Section 2 reaching an ultimate flexural limit state of M_u = 180,000 ft-kip or a flexural Special Permit Test Load capacity of

$$M_{max} = \frac{0.9}{1.2}\ 180,000 = 135,000 \text{ ft-kip (180 MN-m)}$$

The nominal ultimate shear capacity in the heavily post-tensioned reaction wall derived in accordance with ACI 318-83, Section 11.4 is

$$V_n = V_c + V_s$$

where the concrete contribution V_c is limited by

$$V_c = 5\sqrt{f'_c}\, b_w d = 950 \text{ kip (4.2 MN)}$$

The shear reinforcement #8 @ 12 in. (Ø 25 mm @ 30 cm) each face contributes

$$V_s = A_v f_y d/s = 1,330 \text{ kip (5.9 MN)}$$

to a total nominal ultimate capacity of

$$V_n = V_s + V_c = 1,330 + 950 = 2,280 \text{ kip/web (10.1 MN)}$$

or an available maximum capacity of

$$V_{max} + \frac{0.85}{1.2}\ V_n = 1,600 \text{ kip/web 7.1 MN/web)}$$

not considering the access holes in the reaction wall webs.

With six #8 (Ø 25 mm) additional rebars at top and bottom of the manholes as well as additional vertical and diagonal reinforcement as shown in Fig. 8b, the effects of the manholes on the shear capacity of the webs are minimized and a nominal value of

$$V_{max} = 1,500 \text{ kip/web } (6.6 \text{ MN/web})$$

can be assumed which leads to a total available base shear capacity of

$$V_{base} = 3 \times 1,500 = 4,500 \text{ kip } (20 \text{ MN})$$

as the Special Permit Test Load limit.

4.3 Test Load Capacities

Test load capacities are by definition factored by 1.7 to obtain Special Permit Test Loads (see Section 2). Thus available Test Load levels can be obtained from the previously established Special Permit Test Loads by a division with the load factor 1.7.

The most important capacities, TL and (SPTL) are summarized for quick reference in Fig. 22. It should be noted that with the inherent safety factors quasi static, cyclic and dynamic tests up to the Test Load levels can be performed without any further checks on the structural integrity of the reaction wall or test floor. Load applications beyond the Test Load levels and up to the Special Permit Test Loads should always be preceded by a structural analysis of the entire test set up including the appropriate portions of the reaction wall and the test floor.

The tie through holes on a 2 ft (60 cm) module vertical and horizontal in the front and back face of the reaction wall allow additional horizontal post-tensioning which may be necessary in certain applications to ensure high shear capacities or reduced principal tensile stresses. Vertical tie down holes strategically located in the test floor slab around the perimeter of the reaction wall and inside the box sections (see Fig. 6b) can be used for additional vertical post-tensioning of the reaction wall with external bars or tendons if the need for increased flexural capacity every arises.

4.4 Reaction Wall Response Characteristics

Extensive linear elastic finite element models have been employed to predict the static and dynamic response characteristics of the reaction strong wall and the most important findings are discussed in this Section.

Since one of the major objectives and usage criteria is the maintenance of structural integrity (in particular the structural stiffness) in order to provide the proper test environment, stress and deflection checks of the reaction

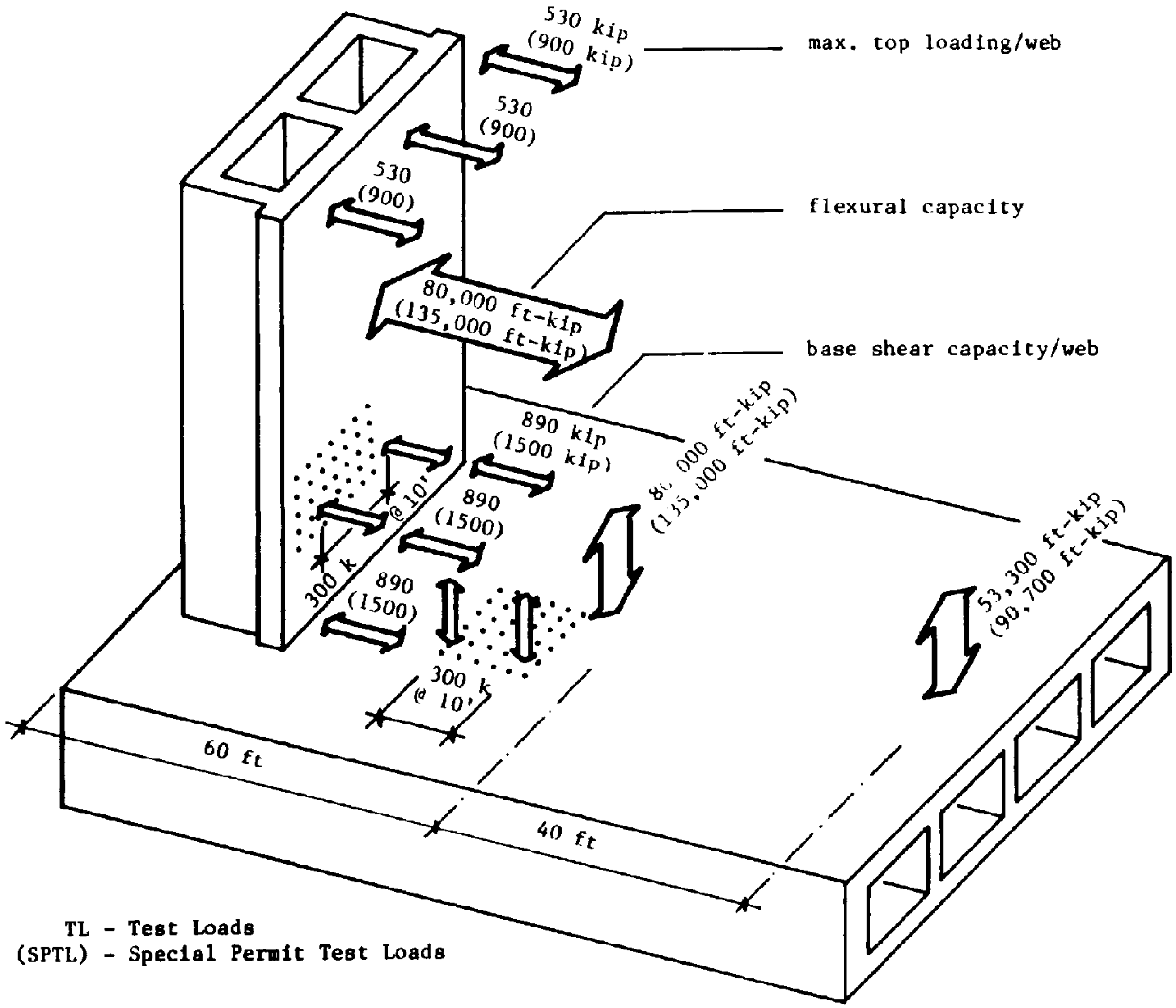


Fig. 22 Reaction Wall and Test Floor Capacity Overview

wall were performed. The nominal uniform initial state of prestress of 850 psi throughout the reaction wall justifies the application of linear elastic analytical models up to very high load levels.

Under a horizontal load of 3 x 900 = 2,700 kip (123 MN) applied at the top of the reaction wall, 2,700 kip (12 MN) at the 50 ft (15 m) level which translates to the maximum moment capacity of 135,000 ft-kip (180 MN-m), the top of the reaction wall showed a horizontal displacement of less than 0.5 in. (13 mm) which corresponds to a stiffness value of

$$K_{top} = \frac{2,700}{0.5} = 5,400 \text{ kip/in } (1 \text{ MN/mm})$$

A detailed stress analysis of critical sections in the reaction wall is presented in Appendix B - Reaction Wall Response Data.

Under the assumption that all three vertical webs carry equal forces, the critical section of an exterior web with man access holes was analyzed for four different load cases as indicated in Appendix B. The analysis showed principal tensile stress levels can reach cracking stress levels in the direct vicinity of the openings under maximum loads. However, it is also shown these principal tensile stresses can be significantly reduced with horizontal post-tensioning.

The principal tensile stress potential shown in Appendix B emphasized again the necessity for separate analytical checks in Special Permit Test Load cases to ensure the structural integrity of the reaction facility.

The dynamic characteristics of the reaction wall were found with a fixed base assumption to be 11.8 Hz, 17.0 Hz and 25.0 Hz for the first three natural frequencies corresponding to flexure about the weak axis, flexure about the strong axis and tension of the box section respectively. The three associated mode shapes are depicted in Fig. 23.

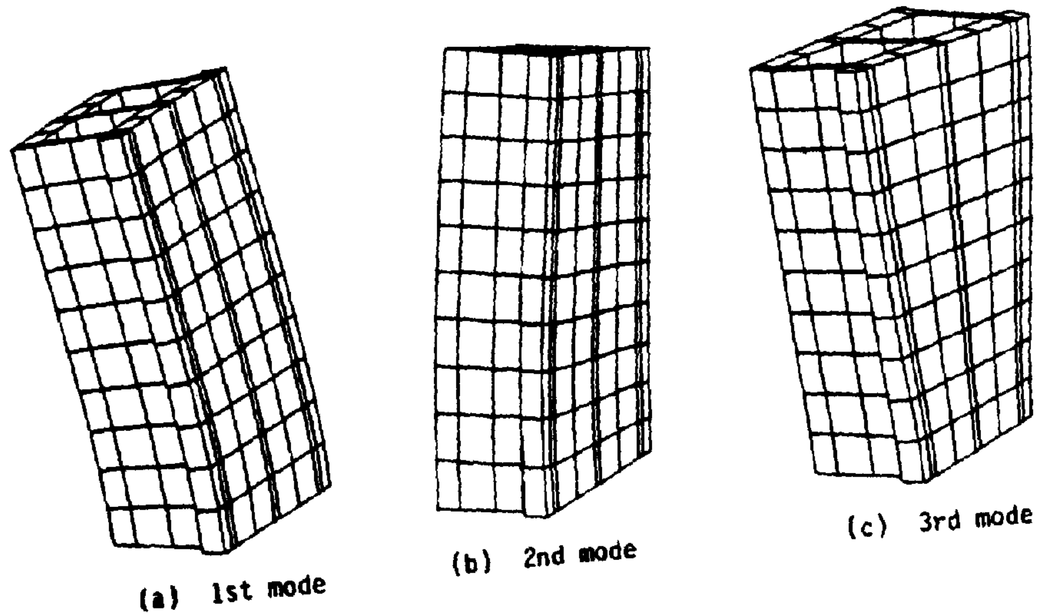


Fig. 23 Dynamic Response of Reaction Wall

5. SUMMARY

The Charles Lee Powell Structural Systems Laboratory at the University of California, San Diego, is one of the few facilities worldwide where full scale structural systems can be subjected to critical loads in an on-line-computer-controlled multi-actuator environment. The structural four-cell box-girder test floor provides a 120 x 50 ft (37 x 15m) test area with tie-down sleeves on a 2 ft (0.6 m) module in each direction. The main feature of the 57 ft (17 m) high laboratory is a heavily post-tensioned reaction wall for the full-scale testing of five story buildings under simulated earthquake loads. The reaction wall dimensions and load capacities make this facility unique in the United States. Full scale structural systems testing will provide the long needed experimental capabilities to verify design procedures and complex analytical models.

6. ACKNOWLEDGEMENTS

The construction of the UCSD Structural Systems Laboratory would not have been possible without the one million dollar grant from the Charles Lee Powell Foundation which is gratefully acknowledged. The National Science Foundation funded the reaction wall and all associated necessary modifications to the laboratory design to accommodate the testing of five story full scale buildings under simulated seismic loads. NSF Grant No. CEE 84-18206 was administered through Dr. John B. Scalzi, who deserves special thanks for his help and support in this project. Dr. M. Gaus and Dr. A.J. Eggenberger's guidance and continued interest in this project are greatly appreciated.

The Technical Coordinating Committee for Masonry Research (TCCMAR) and, in particular the chairman, Dr. James L. Noland, were instrumental in initiating and developing the 50 ft reaction wall concept for the planned testing of five stories of a full scale reinforced concrete masonry research building as part of the U.S./Japan Coordinated Program for Masonry Building Research [5].

The UCSD administration, in particular, Chancellor, Dr. Richard Atkinson and Dean of Engineering, Dr. M. Lea Rudee, made this project possible with their invaluable guidance and their enthusiastic support.

The structural concrete slab for the fabrication yard was donated by the Daley Corporation and H.G. Fenton. The continued support of Ralph T. Richey, President, Daley Corporation, and David M. Miller, Chairman of the Board, H.G. Fenton & Pre-Mixed Concrete, Western Salt, is deeply appreciated.

Laurance T. Berman, Junior Development Engineer, was responsible for the installation and monitoring of the strain gages in the reaction wall and deserves special thanks for putting in odd hours in connection with the laboratory construction.

The report was skillfully typed and proofread by Jan Lightsey, Administrative Assistant for the Structural Research Project.

Most importantly, the entire structures laboratory endeavor was made possible by Professor Dr. Gilbert A. Hegemier's relentless and dedicated commitment and continued effort to establish such a research facility at UCSD.

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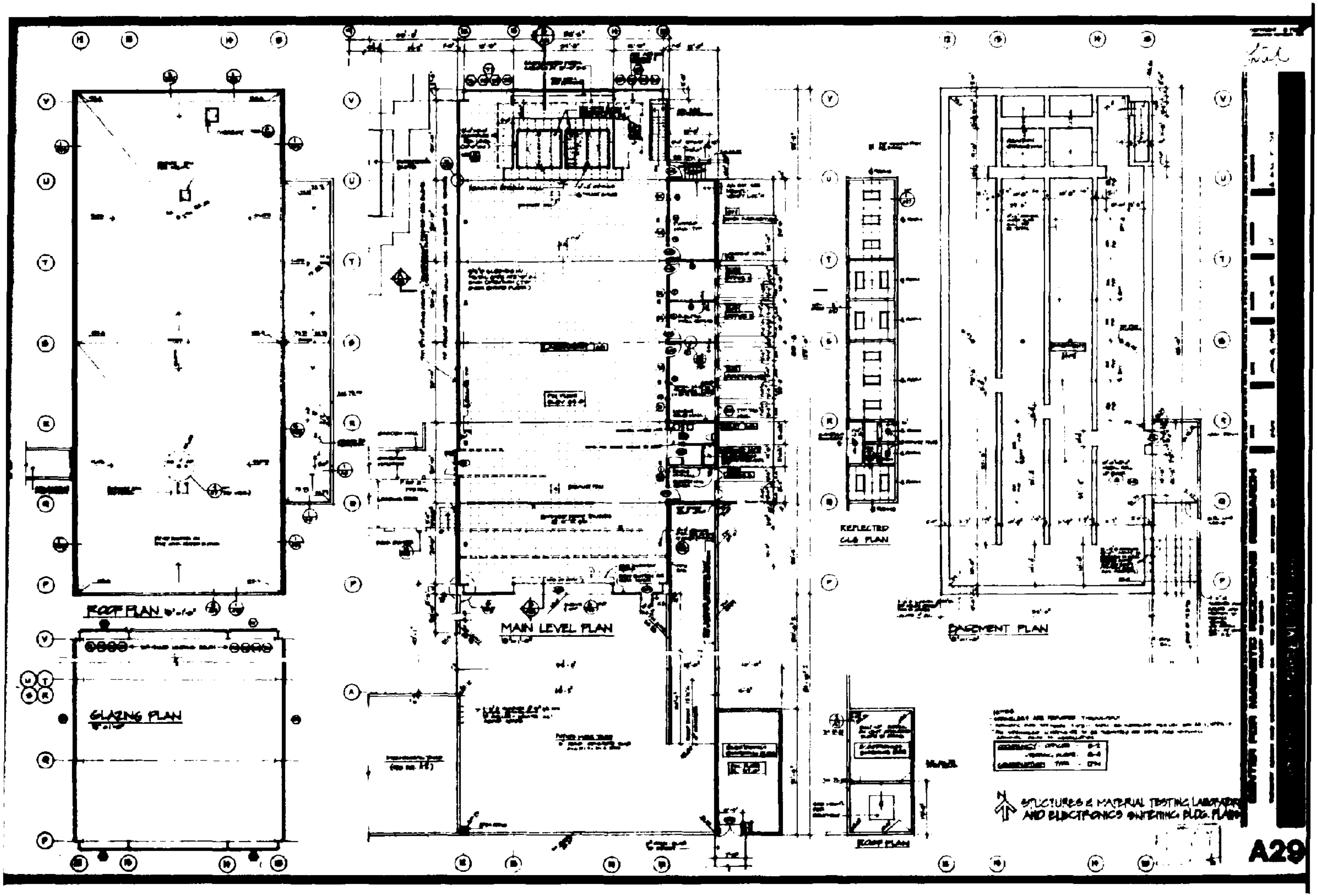
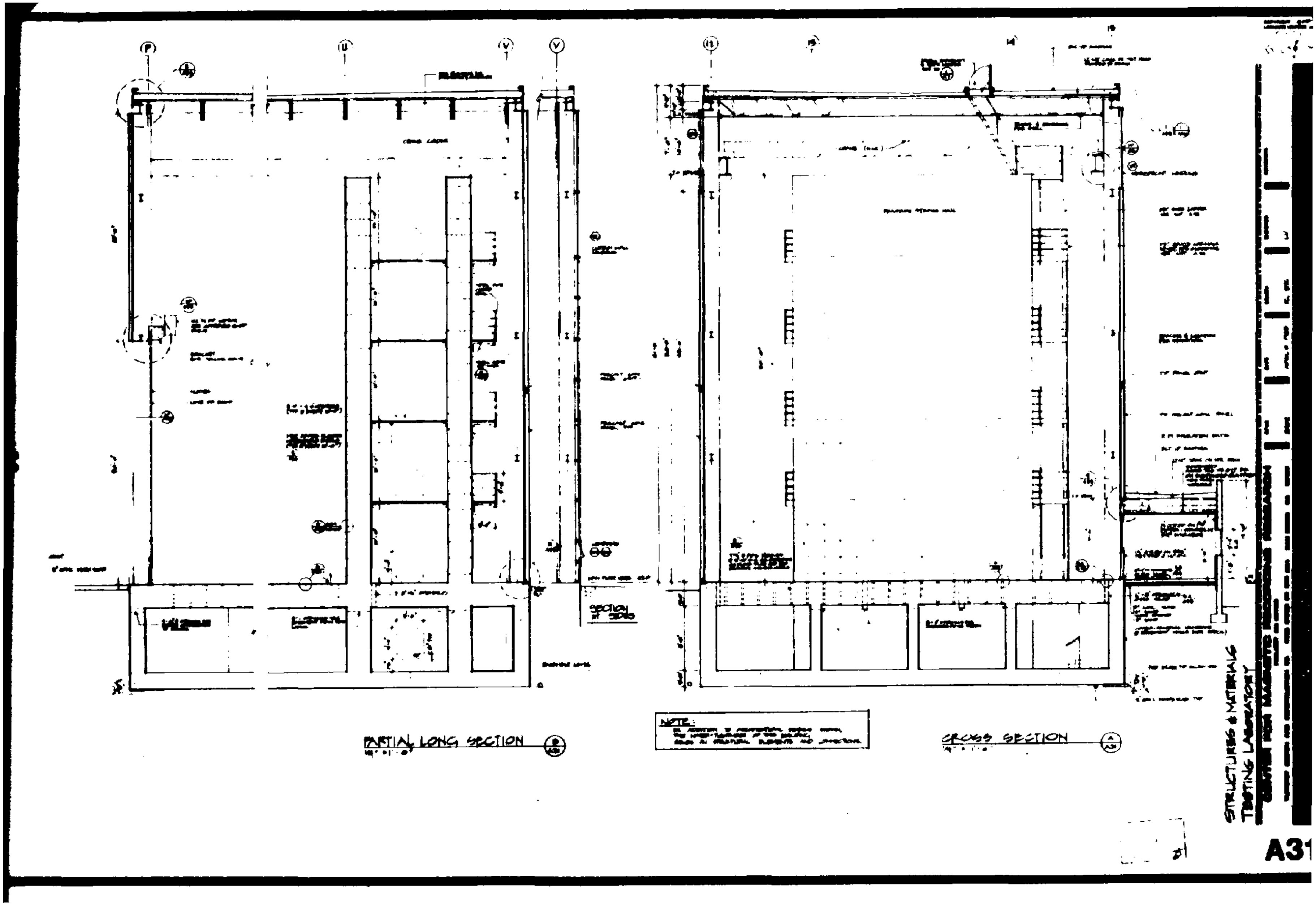
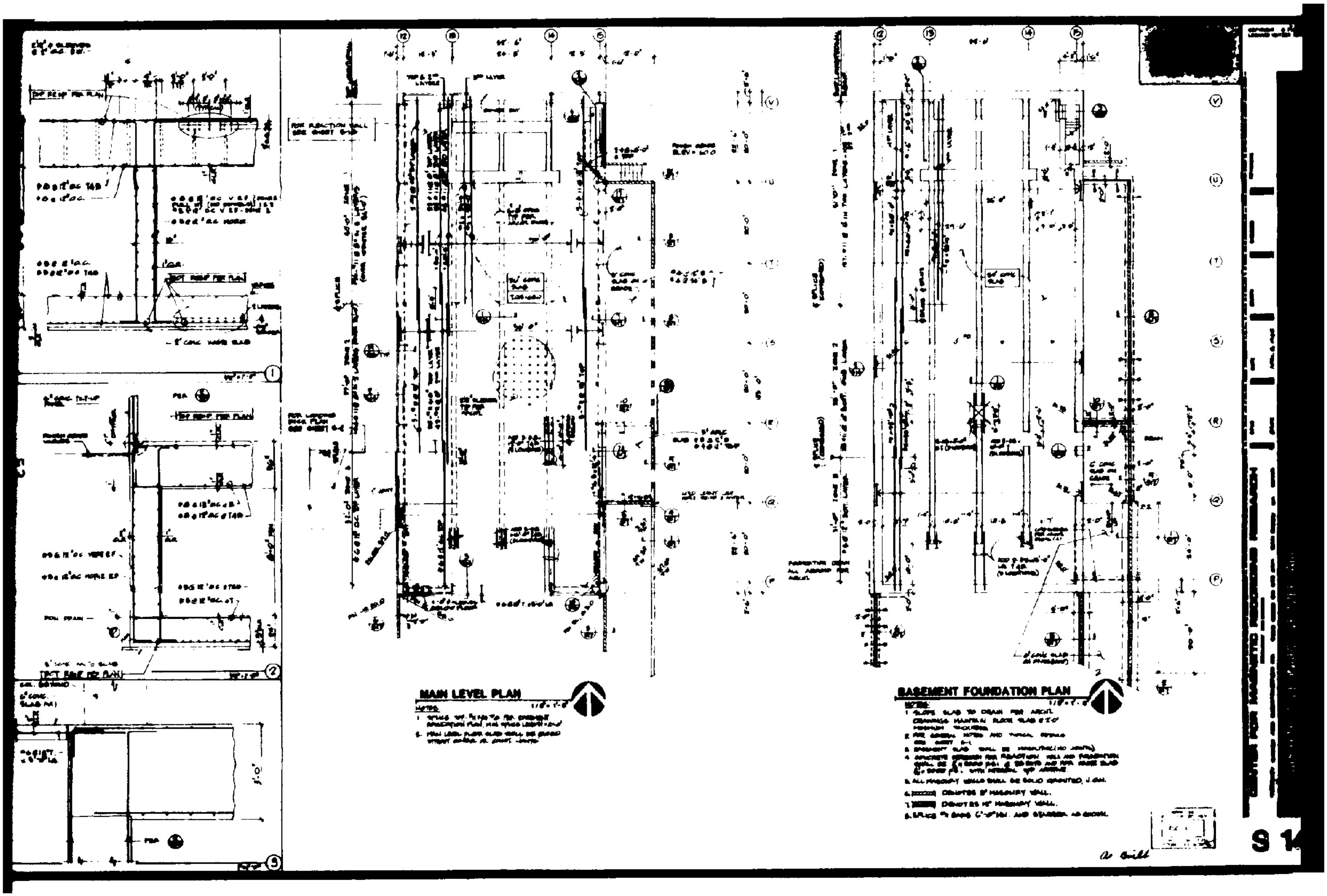
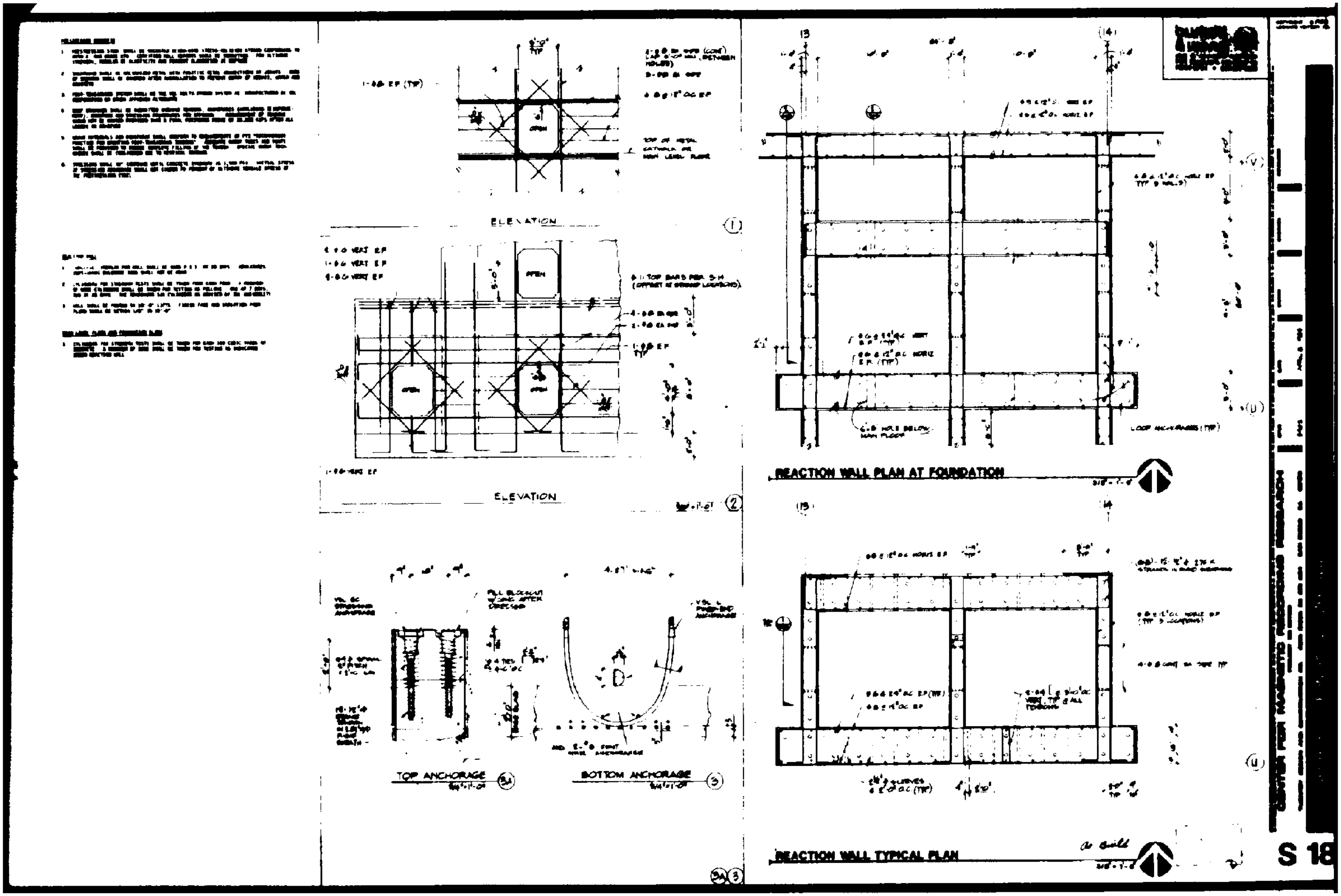
APPENDIX A

Construction Documents


ROOF PLAN
GLAZING PLAN
MAIN LEVEL PLAN
REFLECTED CLG PLAN
BASEMENT PLAN
ROOF PLAN
STRUCTURES & MATERIAL TESTING LABORATORY AND ELECTRONICS ENGINEERING BLDG. PLANS
A29


PARTIAL LONG SECTION
CROSS SECTION
SECTION
NOTE:
STRUCTURES & MATERIALS
TESTING LABORATORY
A31


MAIN LEVEL PLAN
BASEMENT FOUNDATION PLAN
S 14



ELEVATION
ELEVATION
TOP ANCHORAGE
BOTTOM ANCHORAGE
REACTION WALL PLAN AT FOUNDATION
REACTION WALL TYPICAL PLAN
CENTER FOR MAGNETIC RECORDING RESEARCH
S 18

APPENDIX B

Reaction Wall Response Data

1. Overall Structure:

Load Case 1 - vertical prestressing $f_{p,\infty}$ = 740 psi

Load Case 2 - maximum horizontal top loading of 2,700 kip

Load Combinations:

Combination 1 = LC1 + LC2 (STPL)

Combination 2 = LC1 + 0.59 LC2 (TL)

2. Local Stress States:

Load Case 1 - vertical prestressing $f_{p,\infty}$ = 740 psi

Load Case 2 - maximum flexural load of 135,000 ft-kip

Load Case 3 - maximum shear force of 4,500 kip

Load Case 4 - possible horizontal post-tensioning f_p = 500 psi

Load Combinations:

Combination 1 = LC1 + 0.59 LC2 (TL)

Combination 2 = LC1 + 0.59 LC3 (TL)

Combination 3 = LC1 + LC2 + LC4 (SPTL)

Combination 4 = LC1 + LC3 + LC4 (SPTL)

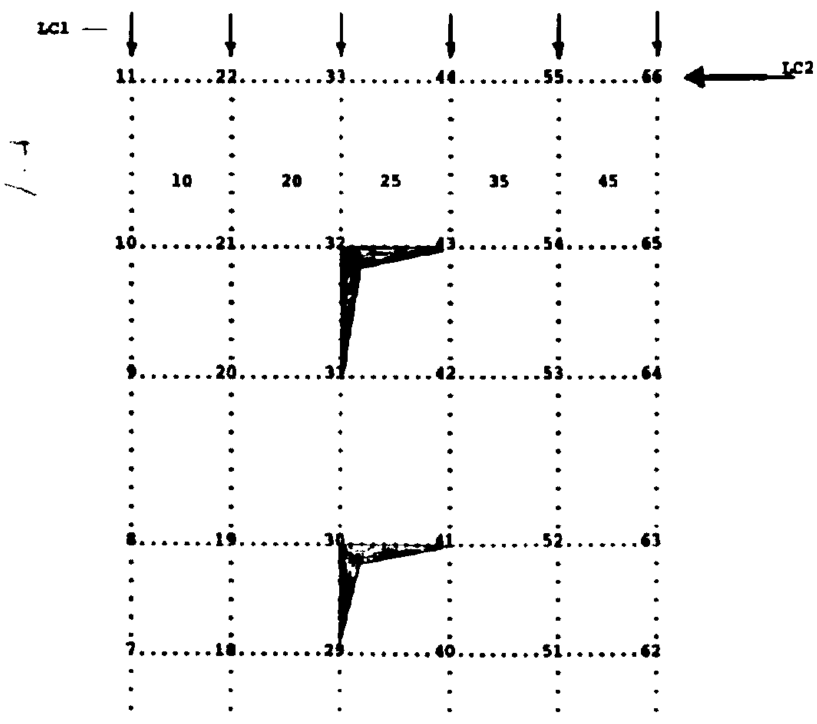
E D S E P - P L O T

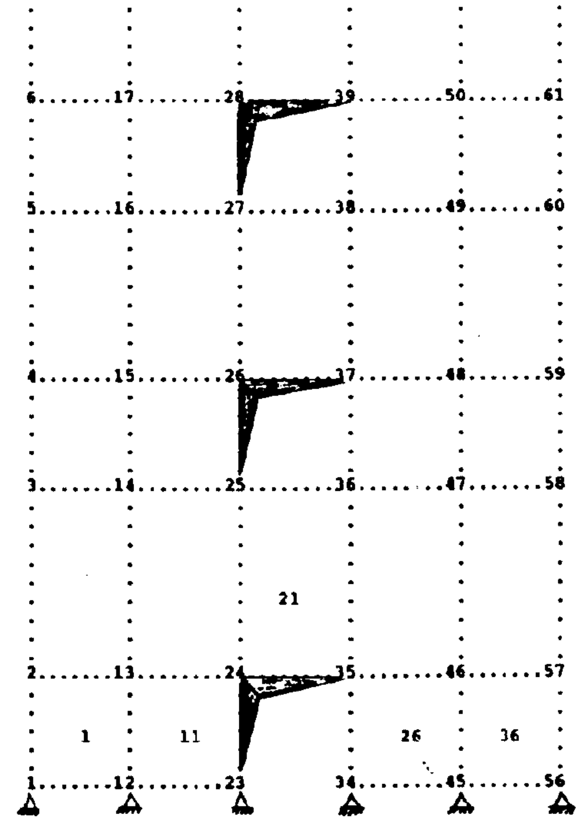
VERSION: NOV. 1986

O U T P U T   O F   P L O T   P R O G R A M

IZONTAL DIRECTION DEFINED BY	I =	1	J =	12
W VECTOR DEFINED BY	P(1) =	2	P(2) =	0

LIMITS =	.0000	.0000
LIMITS =	.0000	.0000
LIMITS =	.0000	.0000





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* * * * * * * * *        PLANE STRESSES      * * * * * * * * * * * *
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-----STRESSES - TWO-D PLANE-STRESS MEMBERS-------

EMENT UMBER	LOAD CASE	Y-COORD	Z-COORD	SIGMA YY SIGMA 1	SIGMA ZZ SIGMA 2	SIGMA YZ THETA
21	1	93.00	84.00	-.1026E+03 -.1026E+03	-.5280E+03 -.5280E+03	-.9026E+00 -.12158
21	2	93.00	84.00	-.3371E+01 .4663E+03	-.3169E+02 -.5014E+03	-.4837E+03 -44.16157
22	1	93.00	204.00	.2549E+01 .2550E+01	-.5403E+03 -.5403E+03	.3066E+00 .03235
22	2	93.00	204.00	-.3425E+00 .6027E+03	-.2264E+02 -.6257E+03	-.6141E+03 -44.47986
23	1	93.00	324.00	.8212E+01 .8212E+01	-.5310E+03 -.5310E+03	.5803E-01 .00617
23	2	93.00	324.00	.2823E+02 .6303E+03	-.1416E+02 -.6162E+03	-.6229E+03 -44.02559
24	1	93.00	444.00	.3542E+02 .3542E+02	-.5423E+03 -.5423E+03	-.4485E+00 -.04448
24	2	93.00	444.00	.4502E+02 .6376E+03	-.6141E+02 -.6539E+03	-.6436E+03 -42.63655
25	1	93.00	564.00	-.3828E+02 -.3828E+02	-.6661E+03 -.6661E+03	.4521E+00 .04126
25	2	93.00	564.00	-.4567E+03 .2633E+03	-.4817E+02 -.7682E+03	-.4735E+03 -56.66707
26	1	130.50	24.00	-.1375E+03 -.1342E+03	-.8594E+03 -.8626E+03	.4872E+02 3.84346
26	2	130.50	24.00	.1504E+03 .4145E+03	.1747E+03 -.8940E+02	-.2517E+03 -46.38271
27	1	130.50	84.00	-.2969E+02 -.2871E+02	-.6489E+03 -.6499E+03	.2464E+02 2.27525
27	2	130.50	84.00	.1448E+02 .4249E+03	.2373E+03 -.1731E+03	-.2775E+03 -55.93743
28	1	130.50	144.00	-.4766E+02 -.4765E+02	-.9615E+03 -.9615E+03	-.4011E+01 -.25147
28	2	130.50	144.00	.3194E+02 .6243E+03	.2728E+03 -.3195E+03	-.4563E+03 -52.39271
29	1	130.50	204.00	.2698E+02 .2699E+02	-.6523E+03 -.6523E+03	-.3135E+01 -.26438
29	2	130.50	204.00	-.1024E+01 .4326E+03	.2386E+03 -.1950E+03	-.2901E+03 -56.22214
30	1	130.50	264.00	-.3210E+02 -.3209E+02	-.9429E+03 -.9429E+03	-.3467E+01 -.21806
30	2	130.50	264.00	.5579E+01 .5982E+03	.2107E+03 -.3820E+03	-.4792E+03 -51.03917
31	1	130.50	324.00	.2689E+02 .2689E+02	-.6460E+03 -.6460E+03	-.6851E+00 -.05834
31	2	130.50	324.00	.1395E+02 .3866E+03	.1698E+03 -.2029E+03	-.2842E+03 -52.66433
32	1	130.50	384.00	-.2592E+02 -.2592E+02	-.9389E+03 -.9389E+03	.2316E+01 .14536
32	2	130.50	384.00	.3131E+02 .5403E+03	.1147E+03 -.3944E+03	-.4655E+03 -47.55778
33	1	130.50	444.00	.4407E+02 .4420E+02	-.6531E+03 -.6532E+03	.9392E+01 .77163
33	2	130.50	444.00	.4030E+02 .3086E+03	.5105E+02 -.2173E+03	-.2629E+03 -45.58583
34	1	130.50	504.00	-.2916E+02 -.2833E+02	-.9926E+03 -.9934E+03	.2836E+02 1.68439
34	2	130.50	504.00	-.2271E+02 .4203E+03	-.1142E+03 -.5571E+03	-.4865E+03 -42.31586
35	1	130.50	564.00	-.1904E+02 -.1110E+02	-.7136E+03 -.7215E+03	.7472E+02 6.07100
35	2	130.50	564.00	-.6208E+03 .1662E+03	.5266E+01 -.7818E+03	-.3559E+03 -65.66722
36	1	168.00 186.00	24.00 .00	-.6683E+02 -.6635E+02 -.1644E+03 -.1585E+03	-.7725E+03 -.7730E+03 -.8218E+03 -.8277E+03	.1852E+02 1.50252 .6251E+02 5.38305
36	2	168.00 186.00	24.00 .00	.7372E+02 .7511E+03 .2428E+03 .1318E+04	.7439E+03 .6651E+02 .1214E+04 .1380E+03	-.6990E+02 -84.10873 -.3356E+03 -72.67264
37	1	168.00 186.00	84.00 48.00	.6310E+01 .6327E+01 .2457E+02 .2466E+02	-.7678E+03 -.7678E+03 -.7538E+03 -.7539E+03	.3552E+01 .26287 -.8291E+01 -.61023
37	2	168.00 186.00	84.00 48.00	-.6085E+01 .6718E+03 .2312E+02 .9072E+03	.6701E+03 -.7787E+01 .8662E+03 -.1788E+02	-.3398E+02 -87.13083 -.1904E+03 -77.84642

38	1	168.00	144.00	-.2438E+01	-.7577E+03	-.1552E+01
				-.2435E+01	-.7577E+03	-.11777
		186.00	120.00	-.5815E+01	-.7511E+03	-.4137E+01
				-.5792E+01	-.7511E+03	-.31802
38	2	168.00	144.00	.4789E+01	.5983E+03	-.4076E+02
				.6011E+03	.2003E+01	-86.08998
		186.00	120.00	.3142E+02	.8077E+03	-.1493E+03
				.8354E+03	.3685E+01	-79.47732
39	1	168.00	204.00	.1779E-01	-.7665E+03	-.1724E+01
				.2166E-01	-.7665E+03	-.12889
		186.00	168.00	.2280E+01	-.7576E+03	-.8818E+01
				.2382E+01	-.7577E+03	-.66476
39	2	168.00	204.00	-.3695E+00	.5156E+03	-.2353E+02
				.5167E+03	-.1441E+01	-87.39415
		186.00	168.00	.2730E+02	.6347E+03	-.1190E+03
				.6572E+03	.4830E+01	-79.30498
40	1	168.00	264.00	.9154E+00	-.7604E+03	-.9410E+00
				.9166E+00	-.7604E+03	-.07082
		186.00	240.00	-.3976E+00	-.7661E+03	.2145E+01
				-.3915E+00	-.7661E+03	.16047
40	2	168.00	264.00	.7833E+00	.4409E+03	-.3748E+02
				.4441E+03	-.2385E+01	-85.16769
		186.00	240.00	.8123E+01	.5773E+03	-.1062E+03
				.5965E+03	-.1105E+02	-79.76738
41	1	168.00	324.00	-.3838E+00	-.7680E+03	-.4339E+00
				-.3836E+00	-.7680E+03	-.03239
		186.00	288.00	.7768E-01	-.7654E+03	-.2495E+01
				.8581E-01	-.7654E+03	-.18672
41	2	168.00	324.00	.3005E+00	.3591E+03	-.2143E+02
				.3603E+03	-.9748E+00	-86.59398
		186.00	288.00	.2049E+02	.4398E+03	-.8616E+02
				.4568E+03	.3477E+01	-78.82836
42	1	168.00	384.00	.1285E+01	-.7609E+03	.4365E+00
				.1286E+01	-.7609E+03	.03281
		186.00	360.00	-.7119E+00	-.7699E+03	.5252E+01
				-.6760E+00	-.7699E+03	.39123
42	2	168.00	384.00	.3242E+01	.2861E+03	-.3184E+02
				.2896E+03	-.2973E+00	-83.65651
		186.00	360.00	.6976E+00	.3813E+03	-.7826E+02
				.3968E+03	-.1477E+02	-78.82234
43	1	168.00	444.00	.6394E+00	-.7662E+03	.3389E+01
				.6544E+00	-.7662E+03	.25321
		186.00	408.00	.2172E+01	-.7575E+03	-.3557E+01
				.2189E+01	-.7576E+03	-.26824
43	2	168.00	444.00	-.1483E+01	.2109E+03	-.9628E+01
				.2114E+03	-.1918E+01	-87.40996
		186.00	408.00	.2649E+02	.2944E+03	-.7689E+02
				.3149E+03	.5993E+01	-75.07340
44	1	168.00	504.00	-.7424E+00	-.7532E+03	.6217E+01
				-.6910E+00	-.7532E+03	.47336
		186.00	480.00	.6991E+01	-.7355E+03	-.4053E+01
				.7013E+01	-.7355E+03	-.31273
44	2	168.00	504.00	.2527E+02	.1452E+03	-.1654E+02
				.1474E+03	.2303E+02	-82.29042
		186.00	480.00	.5189E+01	.3007E+03	-.8915E+02
				.3255E+03	-.1963E+02	-74.44568
45	1	168.00	564.00	-.7114E+00	-.7489E+03	-.1164E+01
				-.7096E+00	-.7489E+03	-.08912
		186.00	528.00	-.1626E+01	-.7366E+03	-.1091E+02
				-.1465E+01	-.7368E+03	-.85000
45	2	168.00	564.00	-.1175E+03	.5459E+02	-.5447E+02
				.7039E+02	-.1333E+03	-73.82982
		186.00	528.00	.7820E+02	.1539E+03	-.1413E+03
				.2623E+03	-.3019E+02	-52.50280

-------- STRESSES - TWO - D PLANE-STRESS MEMBERS ------ LOAD COMBINATIONS ----

LOAD COMB	LOAD CASE MULTIPLIERS 1	2
1	1.00	1.00

ELEMENT NUMBER	LOAD COMB	Y-COORD	Z-COORD	SIGMA YY / SIGMA 1	SIGMA ZZ / SIGMA 2	SIGMA YZ / THETA
21	1	93.00	84.00	-.1060E+03	-.5596E+03	-.4846E+03
				.2022E+03	-.8678E+03	-32.45668
22	1	93.00	204.00	.2207E+01	-.5630E+03	-.6138E+03
				.3953E+03	-.9561E+03	-32.63885
23	1	93.00	324.00	.3645E+02	-.5451E+03	-.6229E+03
				.4331E+03	-.9417E+03	-32.48733
[illegible]	1	93.00	444.00	.8044E+02	-.6037E+03	-.6440E+03
				.4676E+03	-.9908E+03	-31.01234
25	1	93.00	564.00	-.4950E+03	-.7142E+03	-.4731E+03
				-.1190E+03	-.1090E+04	-38.47767
26	1	130.50	24.00	.1292E+02	-.6846E+03	-.2030E+03
				.6768E+02	-.7394E+03	-15.09791
27	1	130.50	84.00	-.1520E+02	-.4117E+03	-.2528E+03
				.1078E+03	-.5347E+03	-25.95123
28	1	130.50	144.00	-.1572E+02	-.6887E+03	-.4603E+03
				.2180E+03	-.9223E+03	-26.91633
29	1	130.50	204.00	.2595E+02	-.4137E+03	-.2932E+03
				.1726E+03	-.5603E+03	-26.56893
30	1	130.50	264.00	-.2652E+02	-.7322E+03	-.4827E+03
				.2185E+03	-.9773E+03	-26.91677
31	1	130.50	324.00	.4083E+02	-.4763E+03	-.2849E+03
				.1670E+03	-.6025E+03	-23.88924
32	1	130.50	384.00	.5385E+01	-.8243E+03	-.4632E+03
				.2123E+03	-.1031E+04	-24.07623
33	1	130.50	444.00	.8437E+02	-.6021E+03	-.2535E+03

				.1678E+03	-.6855E+03	-18.22538
34	1	130.50	504.00	-.5187E+02	-.1107E+04	-.4582E+03
				.1194E+03	-.1278E+04	-20.49039
35	1	130.50	564.00	-.6399E+03	-.7083E+03	-.2812E+03
				-.3908E+03	-.9574E+03	-41.52985
36	1	168.00	24.00	.6887E+01	-.2858E+02	-.5137E+02
				.4350E+02	-.6520E+02	-35.47756
		186.00	.00	.7838E+02	.3919E+03	-.2731E+03
				.5501E+03	-.7975E+02	-59.92843
37	1	168.00	84.00	.2258E+00	-.9763E+02	-.3042E+02
				.8914E+01	-.1063E+03	-15.93677
		186.00	48.00	.4769E+02	.1124E+03	-.1987E+03
				.2813E+03	-.1213E+03	-49.62494
38	1	168.00	144.00	.2351E+01	-.1594E+03	-.4231E+02
				.1275E+02	-.1698E+03	-13.80846
		186.00	120.00	.2561E+02	.5656E+02	-.1535E+03
				.1953E+03	-.1132E+03	-47.87917
39	1	168.00	204.00	-.3518E+00	-.2509E+03	-.2526E+02
				.2169E+01	-.2534E+03	-5.70018
		186.00	168.00	.2958E+02	-.1229E+03	-.1278E+03
				.1021E+03	-.1955E+03	-29.58566
40	1	168.00	264.00	.1699E+01	-.3194E+03	-.3842E+02
				.6231E+01	-.3240E+03	-6.72777
		186.00	240.00	.7726E+01	-.1888E+03	-.1041E+03
				.5260E+02	-.2336E+03	-23.32461
41	1	168.00	324.00	-.8331E-01	-.4089E+03	-.2186E+02
				.1082E+01	-.4101E+03	-3.05212
		186.00	288.00	.2057E+02	-.3256E+03	-.8866E+02
				.4195E+02	-.3470E+03	-13.55986
42	1	168.00	384.00	.4528E+01	-.4748E+03	-.3140E+02
				.6576E+01	-.4769E+03	-3.73211
		186.00	360.00	-.1425E-01	-.3886E+03	-.7301E+02
				.1325E+02	-.4019E+03	-10.29753
43	1	168.00	444.00	-.8435E+00	-.5553E+03	-.6239E+01
				-.7733E+00	-.5554E+03	-.64465
		186.00	408.00	.2866E+02	-.4631E+03	-.8044E+02
				.4149E+02	-.4759E+03	-9.05803
44	1	168.00	504.00	.2453E+02	-.6080E+03	-.1032E+02
				.2470E+02	-.6082E+03	-.93447
		186.00	480.00	.1218E+02	-.4348E+03	-.9320E+02
				.3083E+02	-.4535E+03	-11.31825
45	1	168.00	564.00	-.1182E+03	-.6944E+03	-.5564E+02
				-.1129E+03	-.6997E+03	-5.46560
		186.00	528.00	.7657E+02	-.5827E+03	-.1522E+03
				.1100E+03	-.6161E+03	-12.39134

LOAD COMB	LOAD CASE MULTIPLIERS 1	2
2	1.00	.59

ELEMENT NUMBER	LOAD COMB	Y-COORD	Z-COORD	SIGMA YY SIGMA 1	SIGMA ZZ SIGMA 2	SIGMA YZ THETA
21	2	93.00	84.00	-.1046E+03	-.5467E+03	-.2863E+03
				.3605E+02	-.6873E+03	-26.16289
22	2	93.00	204.00	.2347E+01	-.5537E+03	-.3620E+03
				.1808E+03	-.7321E+03	-26.23760
23	2	93.00	324.00	.2487E+02	-.5393E+03	-.3675E+03
				.2060E+03	-.7205E+03	-26.24387
24	2	93.00	444.00	.6198E+02	-.5785E+03	-.3801E+03
				.2388E+03	-.7553E+03	-24.94397
25	2	93.00	564.00	-.3078E+03	-.6945E+03	-.2789E+03
				-.1617E+03	-.8405E+03	-27.63496
26	2	130.50	24.00	-.4875E+02	-.7563E+03	-.9977E+02
				-.3495E+02	-.7701E+03	-7.87508
27	2	130.50	84.00	-.2114E+02	-.5089E+03	-.1391E+03
				.1572E+02	-.5458E+03	-14.84532
28	2	130.50	144.00	-.2882E+02	-.8005E+03	-.2732E+03
				.5812E+02	-.8874E+03	-17.65074
29	2	130.50	204.00	.2637E+02	-.5115E+03	-.1743E+03
				.7789E+02	-.5631E+03	-16.47048
30	2	130.50	264.00	-.2881E+02	-.8186E+03	-.2862E+03
				.6401E+02	-.9114E+03	-17.96705
31	2	130.50	324.00	.3512E+02	-.5459E+03	-.1684E+03
				.8039E+02	-.5912E+03	-15.04953
32	2	130.50	384.00	-.7451E+01	-.8713E+03	-.2723E+03
				.7124E+02	-.9500E+03	-16.11611
33	2	130.50	444.00	.6785E+02	-.6230E+03	-.1457E+03
				.9733E+02	-.6525E+03	-11.43656
34	2	130.50	504.00	-.4256E+02	-.1060E+04	-.2587E+03
				.1945E+02	-.1122E+04	-13.47812
35	2	130.50	564.00	-.3853E+03	-.7105E+03	-.1353E+03
				-.3364E+03	-.7594E+03	-19.88048
36	2	168.00	24.00	-.2334E+02	-.3336E+03	-.2272E+02
				-.2168E+02	-.3352E+03	-4.16586
		186.00	.00	-.2114E+02	-.1057E+03	-.1355E+03
				.7852E+02	-.2054E+03	-36.33374
37	2	168.00	84.00	.2720E+01	-.3724E+03	-.1649E+02
				.3444E+01	-.3731E+03	-2.51297
		186.00	48.00	.3821E+02	-.2427E+03	-.1206E+03
				.8289E+02	-.2874E+03	-20.32637
38	2	168.00	144.00	.3875E+00	-.4047E+03	-.2560E+02
				.1999E+01	-.4063E+03	-3.60163
		186.00	120.00	.1273E+02	-.2746E+03	-.9225E+02
				.3979E+02	-.3016E+03	-16.35323
39	2	168.00	204.00	-.2002E+00	-.4623E+03	-.1561E+02
				.3264E+03	-.4628E+03	-1.93249
		186.00	168.00	.1838E+02	-.3832E+03	-.7900E+02
				.3337E+02	-.3981E+03	-10.73970

[illegible]0	2	168.00	264.00	.1378E+01	-.5002E+03	-.2305E+02
				.2435E+01	-.5013E+03	-2.62582
		186.00	240.00	.4395E+01	-.4?55E+03	-.6052E+02
				.1275E+02	-.4338E+03	-7.86315
41	2	168.00	324.00	-.2065E+00	-.5561E+03	-.1308E+02
				.1009E+00	-.5564E+03	-1.34668
		186.00	288.00	.1217E+02	-.5059E+03	-.5333E+02
				.1760E+02	-.5114E+03	-5.81637
42	2	168 90	384.00	.3198E+01	-.5921E+03	-.1835E+02
				.3763E+01	-.5927E+03	-1.76364
		186.00	360.00	-.3003E+00	-.5449E+03	-.4092E+02
				.2757E+01	-.5480E+03	-4.27313
43	2	168.00	444.00	-.2355E+00	-.6418E+03	-.2292E+01
				-.2273E+00	-.6418E+03	-.20467
		186.00	408.00	.1780E+02	-.5838E+03	-.4892E+02
				.2175E+02	-.5878E+03	-4.61851
44	2	168.00	504.00	.1417E+02	-.6675E+03	-.3540E+01
				.1419E+02	-.6675E+03	-.29751
		186.00	480.00	.1005E+02	-.5581E+03	-.5665E+02
				.1565E+02	-.5637E+^3	-5.63908
45	2	168.00	564.00	-.7002E+02	-.7167E+03	-.3330E+02
				-.6831E+02	-.7184E+03	-2.94020
		186.00	528.00	.4451E+02	-.6458E+03	-.9426E+02
				.5715E+02	-.6584E+03	-7.63760

D OF RESULTS PRODUCED FROM INPUT FILE "w4111 "

D OF RESULTS PRODUCED FROM INPUT FILE "

--- A C T I V E   G L O B A L   L O A D S ----

NODE	CASE	F(X)	F(Y)	F(Z)	M(X)	M(Y)	M(Z)
11	1	.000E+00	.000E+00	-.405E+07	.000E+00	.000E+00	.000E+00
22	1	.000E+00	.000E+00	-.474E+07	.000E+00	.000E+00	.000E+00
33	1	.000E+00	.000E+00	-.133E+07	.000E+00	.000E+00	.000E+00
44	1	.000E+00	.000E+00	-.133E+07	.000E+00	.000E+00	.000E+0)
55	1	.000E+00	.000E+00	-.541E+07	.000E+00	.000E+00	.000E+00
66	1	.000E+00	.000E+00	-.472E+07	.000E+00	.000E+00	.000E+00
66	2	.000E+00	-.270E+07	.000E+00	.000E+00	.000E+00	.000E+00

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**************************************************************
**                                                          **
**                  E D S E P - P L O T                     **
**                                                          **
**                  VERSION:  NOV. 1986                     **
**************************************************************
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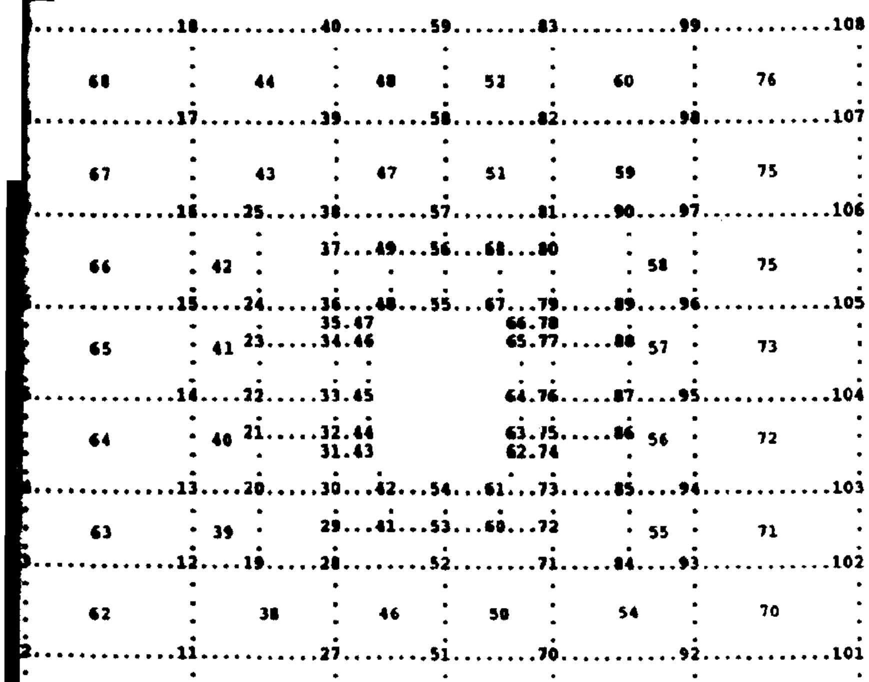
* * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
* * * *   O U T P U T   O F   P L O T   P R O G R A M   * * * *
* * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
```

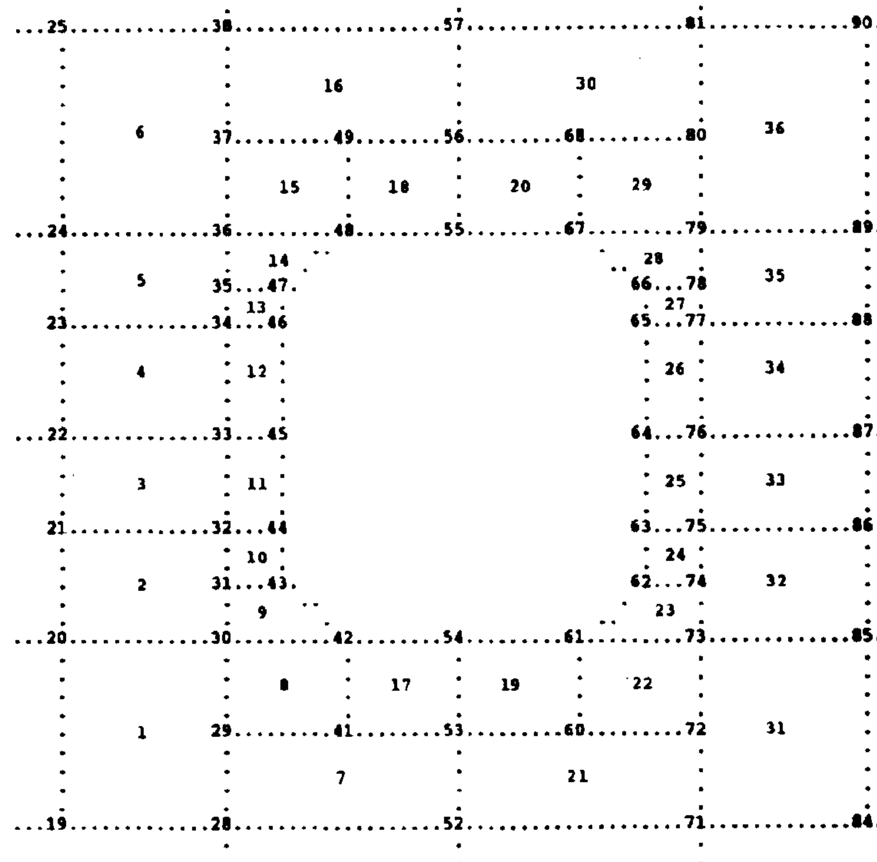
```
[cut off]ZONTAL DIRECTION DEFINED BY   I =   1      J =  10
[cut off] VECTOR DEFINED BY          P(1) =   2   P(2) =   0

[cut off]IMITS =          .0000          .0000
[cut off]IMITS =          .0000          .0000
[cut off]IMITS =          .0000          .0000
```



```
.     61     .     37     .   45   .   49   .    53    .     69     .
.                                                                   .
1............10..........26.......50.......69..........91..........100
HORIZONTAL DIRECTION DEFINED BY   I =   1      J =  10
VIEW VECTOR DEFINED BY          P(1) =   2   P(2) =   0

X-LIMITS =          .0000          .0000
Y-LIMITS =        50.0000       135.0000
Z-LIMITS =        45.0000       147.0000
```



--- A C T I V E   G L O B A L   L O A D S ----

NODE	CASE	F(X)	F(Y)	F(Z)	M(X)	M(Y)	M(Z)
9	1	.000E+00	.000E+00	-.405E+07	.000E+00	.000E+00	.000E+00
18	1	.000E+00	.000E+00	-.464E+07	.000E+00	.000E+00	.000E+00
40	1	.000E+00	.000E+00	-.101E+07	.000E+00	.000E+00	.000E+00
59	1	.000E+00	.000E+00	-.852E+06	.000E+00	.000E+00	.000E+00
83	1	.000E+00	.000E+00	-.101E+07	.000E+00	.000E+00	.000E+00
99	1	.000E+00	.000E+00	-.530E+07	.000E+00	.000E+00	.000E+00
108	1	.000E+00	.000E+00	-.472E+07	.000E+00	.000E+00	.000E+00
18	2	.000E+00	.000E+00	-.142E+08	.000E+00	.000E+00	.000E+00
99	2	.000E+00	.000E+00	.142E+08	.000E+00	.000E+00	.000E+00
9	3	.000E+00	-.844E+06	.000E+00	.000E+00	.000E+00	.000E+00
18	3	.000E+00	-.967E+06	.000E+00	.000E+00	.000E+00	.000E+00
40	3	.000E+00	-.211E+06	.000E+00	.000E+00	.000E+00	.000E+00
59	3	.000E+00	-.178E+06	.000E+00	.000E+00	.000E+00	.000E+00
83	3	.000E+00	-.211E+06	.000E+00	.000E+00	.000E+00	.000E+00
99	3	.000E+00	-.111E+07	.000E+00	.000E+00	.000E+00	.000E+00
[illegible]8	3	.000E+00	-.983E+06	.000E+00	.000E+00	.000E+00	.000E+00
1	4	.000E+00	.288E+06	.000E+00	.000E+00	.000E+00	.000E+00
2	4	.000E+00	.576E+06	.000E+00	.000E+00	.000E+00	.000E+00
3	4	.000E+00	.576E+06	.000E+00	.000E+00	.000E+00	.000E+00
4	4	.000E+00	.576E+06	.000E+00	.000E+00	.000E+00	.000E+00
5	4	.000E+00	.576E+06	.000E+00	.000E+00	.000E+00	.000E+00
6	4	.000E+00	.576E+06	.000E+00	.000E+00	.000E+00	.000E+00
7	4	.000E+00	.576E+06	.000E+00	.000E+00	.000E+00	.000E+00
8	4	.000E+00	.576E+06	.000E+00	.000E+00	.000E+00	.000E+00
9	4	.000E+00	.288E+06	.000E+00	.000E+00	.000E+00	.000E+00
100	4	.000E+00	-.288E+06	.000E+00	.000E+00	.000E+00	.000E+00
101	4	.000E+00	-.576E+06	.000E+00	.000E+00	.000E+00	.000E+00
102	4	.000E+00	-.576E+06	.000E+00	.000E+00	.000E+00	.000E+00
103	4	.000E+00	-.576E+06	.000E+00	.000E+00	.000E+00	.000E+00
104	4	.000E+00	-.576E+06	.000E+00	.000E+00	.000E+00	.000E+00
105	4	.000E+00	-.576E+06	.000E+00	.000E+00	.000E+00	.000E+00
106	4	.000E+00	-.576E+06	.000E+00	.000E+00	.000E+00	.000E+00
107	4	.000E+00	-.576E+06	.000E+00	.000E+00	.000E+00	.000E+00
108	4	.000E+00	-.288E+06	.000E+00	.000E+00	.000E+00	.000E+00

E D S E P - F P L N

VERSION: SEPT. 1986

PLANE STRESSES

-------STRESSES - TWO-D PLANE-STRESS MEMBERS-------

ELEMENT NUMBER	LOAD CASE	Y-COORD	Z-COORD	SIGMA YY SIGMA 1	SIGMA ZZ SIGMA 2	SIGMA YZ THETA
1	1	60.75	60.00	.3927E+02 .3927E+02	-.8292E+03 -.8292E+03	.2065E+00 .01362
1	2	60.75	60.00	.1509E+02 .1509E+02	-.6643E+03 -.6643E+03	.1411E+01 .11903
1	3	60.75	60.00	.2144E+03 .6333E+03	.2824E+03 -.1365E+03	-.3834E+03 -47.53226
1	4	60.75	60.00	-.3483E+03 .2319E+02	-.3376E+01 -.3749E+03	.9934E+02 75.02989
2	1	60.75	78.00	-.1117E+03 -.1117E+03	-.9420E+03 -.9420E+03	.1199E+01 .08273
2	2	60.75	78.00	-.1213E+03 -.1116E+03	-.7353E+03 -.7450E+03	.7770E+02 7.10152
2	3	60.75	78.00	.5015E+03 .9902E+03	.2575E+03 -.2313E+03	-.5984E+03 -39.23834
2	4	60.75	78.00	-.2541E+03 .1196E+03	.2343E+02 -.3502E+03	.1895E+03 63.10608
3	1	60.75	90.00	-.1087E+03 -.1087E+03	-.1051E+04 -.1051E+04	-.2128E+01 -.12938
3	2	60.75	90.00	-.3876E+01 .3875E+02	-.7576E+03 -.8002E+03	.1842E+03 13.02611
3	3	60.75	90.00	.1512E+03 .7720E+03	.6284E+02 -.5579E+03	-.6635E+03 -43.09410
3	4	60.75	90.00	-.1169E+03 .7761E+02	.4524E+02 -.1493E+03	.7935E+02 67.80793
4	1	60.75	102.00	-.1113E+03 -.1079E+03	-.1060E+04 -.1064E+04	-.5694E+02 -3.42075
4	2	60.75	102.00	.2770E+03 .3539E+03	-.6948E+03 -.7717E+03	.2840E+03 15.15195
4	3	60.75	102.00	-.2543E+03	-.1515E+03	-.5936E+03

				.4926E+03	-.8985E+03	-47.11904
4	4	60.75	102.00	-.1261E+03 .5379E+02	.5377E+02 -.1261E+03	-.1742E+01 -89.44520
5	1	60.75	114.00	-.1138E+03 -.1111E+03	-.9791E+03 -.9818E+03	-.4862E+02 -3.20581
5	2	60.75	114.00	.7053E+03 .8574E+03	-.6919E+03 -.8440E+03	.4855E+03 17.39741
5	3	60.75	114.00	-.6882E+03 .2328E+03	-.3261E+03 -.1247E+04	-.7174E+03 -52.08067
5	4	60.75	114.00	-.2980E+03 .1107E+03	.5968E+02 -.3490E+03	-.1445E+03 -70.53268
6	1	60.75	132.00	.8662E+02 .8927E+02	-.8904E+03 -.8930E+03	-.5098E+02 -2.97901
6	2	60.75	132.00	.6383E+03 .8127E+03	-.8488E+03 -.1023E+04	.5381E+03 17.94756
6	3	60.75	132.00	-.3720E+03 .1817E+03	-.2859E+03 -.8396E+03	-.5089E+03 -47.41623
6	4	60.75	132.00	-.5363E+03 .6301E+02	.6631E+02 -.5390E+03	-.4044E+02 -86.17803
7	1	81.00	54.00	-.3294E+02 .1408E+02	-.3297E+03 -.3767E+03	.1271E+03 20.29709
7	2	81.00	54.00	.2362E+01 .7314E+02	-.2778E+03 -.3486E+03	.1576E+03 24.18259
7	3	81.00	54.00	.5537E+01 .8906E+03	.4572E+03 -.4279E+03	-.6193E+03 -55.01573
7	4	81.00	54.00	-.3987E+03 -.1204E+03	-.1243E+03 -.4025E+03	.3267E+02 83.30399
8	1	75.00	66.00	-.9394E+00 .8019E+02	-.6112E+03 -.6923E+03	.2368E+03 18.90876
8	2	75.00	66.00	-.1150E+03 -.4247E+02	-.4944E+03 -.5668E+03	.1810E+03 21.82551
8	3	75.00	66.00	.5552E+03 .1101E+04	.5954E+03 .4992E+02	-.5250E+03 -46.09656
8	4	75.00	66.00	-.4925E+03 -.5302E+02	-.6579E+02 -.5052E+03	.7491E+02 80.32602
9	1	73.50	75.00	-.8381E+02 -.1718E+02	-.9942E+03 -.1061E+04	.2551E+03 14.63533
9	2	73.50	75.00	-.2317E+03 -.1046E+03	-.8686E+03 -.9958E+03	.3117E+03 22.19294
9	3	73.50	75.00	.8895E+03 .1990E+04	.1219E+04 .1184E+03	-.9213E+03 -50.07171
9	4	73.50	75.00	-.4077E+03 .4647E+02	-.1109E+03 -.5651E+03	.2674E+03 59.51425
10	1	72.00	81.00	-.1434E+03	-.1395E+04	.2035E+03

				-.1112E+03	-.1428E+04	9.00394
10	2	72.00	81.00	-.1553E+03 -.1094E+03	-.1142E+04 -.1188E+04	.2178E+03 11.90311
10	3	72.00	81.00	.3872E+03 .1455E+04	.1147E+04 .7923E+02	-.5735E+03 -61.76816
10	4	72.00	81.00	-.9753E+02 .1174E+03	.6210E+02 -.1528E+03	.1090E+03 63.10839
11	1	72.00	90.00	-.2615E+02 -.2471E+02	-.1233E+04 -.1234E+04	.4173E+02 1.97862
11	2	72.00	90.00	-.1851E+02 -.1453E+02	-.8962E+03 -.9001E+03	.5924E+02 3.84446
11	3	72.00	90.00	.4655E+02 .5096E+03	.4083E+03 -.5475E+02	-.2166E+03 -64.93365
11	4	72.00	90.00	-.9346E+01 .1775E+03	.1703E+03 -.1653E+02	.3665E+02 78.90203
12	1	72.00	102.00	-.2904E+02 -.2583E+02	-.1268E+04 -.1271E+04	-.6308E+02 -2.90631
12	2	72.00	102.00	.3492E+02 .5066E+02	-.6258E+03 -.6415E+03	.1032E+03 8.67305
12	3	72.00	102.00	-.5749E+02 .7350E+02	-.3757E+03 -.5067E+03	-.2426E+03 -28.37008
12	4	72.00	102.00	-.5952E+01 .2225E+03	.2225E+03 -.5983E+01	-.2662E+01 -89.33253
13	1	72.00	111.00	-.1609E+03 -.1184E+03	-.1491E+04 -.1533E+04	-.2415E+03 -9.98037
13	2	72.00	111.00	.3256E+03 .5295E+03	-.2098E+03 -.4137E+03	.3883E+03 27.70764
13	3	72.00	111.00	-.4738E+03 -.7185E+02	-.1197E+04 -.1599E+04	-.6725E+03 -30.86458
13	4	72.00	111.00	-.8569E+02 .2132E+03	.2008E+03 -.9809E+02	-.6088E+02 -78.48655
14	1	73.50	117.00	-.8034E+02 -.1182E+01	-.1081E+04 -.1160E+04	-.2923E+03 -15.15050
14	2	73.50	117.00	.9682E+03 .1510E+04	.2686E+03 -.2732E+03	.8201E+03 33.45097
14	3	73.50	117.00	-.1120E+04 -.1022E+03	-.1358E+04 -.2376E+04	-.1130E+04 -41.98568
14	4	73.50	117.00	-.4720E+03 .1029E+03	-.2820E+01 -.5777E+03	-.2466E+03 -66.78762
15	1	75.00	126.00	.4585E+02 .1473E+03	-.6705E+03 -.7720E+03	-.2881E+03 -19.40597
15	2	75.00	126.00	.8295E+03 .1065E+04	-.5311E+01 -.2404E+03	.5015E+03 25.11357
15	3	75.00	126.00	-.7777E+03	-.6633E+03	-.6702E+03

				-.4787E+02	-.1393E+04	-47.43891
15	4	75.00	126.00	-.6796E+03	.4950E+01	-.1189E+02
				.5157E+01	-.6798E+03	-89.00538
16	1	81.00	138.00	.4281E+02	-.3791E+03	-.1607E+03
				.9703E+02	-.4333E+03	-18.64843
16	2	81.00	138.00	.2647E+03	.1273E+03	.8492E+03
				.1048E+04	-.6560E+03	42.68726
16	3	81.00	138.00	-.1053E+03	-.5139E+03	-.8567E+03
				.5712E+03	-.1190E+04	-38.29341
16	4	81.00	138.00	-.6762E+03	-.5715E+02	.5598E+01
				-.5710E+02	-.6762E+03	89.48194
17	1	87.00	66.00	.1035E+03	-.1799E+03	.7727E+02
				.1232E+03	-.1996E+03	14.30288
17	2	87.00	66.00	-.7582E+02	-.1746E+03	.1242E+03
				.8494E+01	-.2589E+03	34.16308
17	3	87.00	66.00	.3417E+03	.3735E+03	-.5570E+03
				.9148E+03	-.1996E+03	-45.81721
17	4	87.00	66.00	-.6380E+03	-.9383E+02	.6334E+02
				-.8656E+02	-.6452E+03	83.44688
18	1	87.00	126.00	.1893E+03	-.2088E+03	-.9386E+02
				.2103E+03	-.2298E+03	-12.62288
18	2	87.00	126.00	.4185E+03	.2277E+03	.6840E+03
				.1014E+04	-.3675E+03	41.02864
18	3	87.00	126.00	-.4362E+03	-.4331E+03	-.7230E+03
				.2884E+03	-.1158E+04	-45.06196
18	4	87.00	126.00	-.8979E+03	-.6287E+02	-.4603E+02
				-.6034E+02	-.9004E+03	-86.85438
19	1	99.00	66.00	.1016E+03	-.1813E+03	-.8035E+02
				.1229E+03	-.2025E+03	-14.79904
19	2	99.00	66.00	.6850E+02	.1490E+03	.1123E+03
				.2281E+03	-.1059E+02	54.85429
19	3	99.00	66.00	-.3171E+03	-.3857E+03	-.5619E+03
				.2116E+03	-.9144E+03	-43.25393
19	4	99.00	66.00	-.6344E+03	-.9130E+02	-.5746E+02
				-.8529E+02	-.6404E+03	-84.02636
20	1	99.00	126.00	.1886E+03	-.2088E+03	.9499E+02
				.2102E+03	-.2304E+03	12.77386
20	2	99.00	126.00	-.4058E+03	-.2470E+03	.6915E+03
				.3696E+03	-.1022E+04	48.27388
20	3	99.00	126.00	.4225E+03	.4226E+03	-.7190E+03
				.1142E+04	-.2964E+03	-45.00129
20	4	99.00	126.00	-.8968E+03	-.6266E+02	.4418E+02
				-.6033E+02	-.8991E+03	86.97632
21	1	105.00	54.00	-.3361E+02	-.3311E+03	-.1311E+03

				.1591E+02	-.3806E+03	-20.69452
21	2	105.00	54.00	-.2091E+02	.2325E+03	.1392E+03
				.2941E+03	-.8247E+02	66.15083
21	3	105.00	54.00	.6020E+01	-.4800E+03	-.6283E+03
				.4367E+03	-.9107E+03	-34.42713
21	4	105.00	54.00	-.3970E+03	-.1216E+03	-.2480E+02
				-.1194E+03	-.3992E+03	-84.89555
22	1	111.00	66.00	-.4589E+01	-.6123E+03	-.2397E+03
				.7858E+02	-.6954E+03	-19.13484
22	2	111.00	66.00	.9791E+02	.4163E+03	.1475E+03
				.4741E+03	.4004E+02	68.58642
22	3	111.00	66.00	-.5418E+03	-.6396E+03	-.5417E+03
				-.4682E+02	-.1135E+04	-42.42077
22	4	111.00	66.00	-.4852E+03	-.6374E+02	-.6943E+02
				-.5259E+02	-.4963E+03	-80.88217
23	1	112.50	75.00	-.8850E+02	-.9965E+03	-.2595E+03
				-.1958E+02	-.1065E+04	-14.87460
23	2	112.50	75.00	.2080E+03	.7434E+03	.2708E+03
				.8565E+03	.9486E+02	67.33411
23	3	112.50	75.00	-.8869E+03	-.1292E+04	-.9355E+03
				-.1324E+03	-.2047E+04	-38.88984
23	4	112.50	75.00	-.3988E+03	-.1066E+03	-.2592E+03
				.4486E+02	-.5502E+03	-59.70278
24	1	114.00	81.00	-.1452E+03	-.1395E+04	-.2057E+03
				-.1122E+03	-.1428E+04	-9.11057
24	2	114.00	81.00	.1341E+03	.9757E+03	.1887E+03
				.1016E+04	.9374E+02	77.92124
24	3	114.00	81.00	-.3960E+03	-.1254E+04	-.5877E+03
				-.9729E+02	-.1552E+04	-26.94010
24	4	114.00	81.00	-.9424E+02	.6178E+02	-.1049E+03
				.1145E+03	-.1469E+03	-63.32197
25	1	114.00	90.00	-.2638E+02	-.1230E+04	-.4246E+02
				-.2489E+02	-.1232E+04	-2.01783
25	2	114.00	90.00	.1496E+02	.7538E+03	.5285E+02
				.7576E+03	.1120E+02	85.92937
25	3	114.00	90.00	-.4822E+02	-.5013E+03	-.2204E+03
				.4128E+02	-.5908E+03	-22.10517
25	4	114.00	90.00	-.8916E+01	.1658E+03	-.3544E+02
				.1727E+03	-.1583E+02	-78.95719
26	1	114.00	102.00	-.2910E+02	-.1264E+04	.6306E+02
				-.2589E+02	-.1268E+04	2.91512
26	2	114.00	102.00	-.3805E+02	.4836E+03	.1099E+03
				.5057E+03	-.6024E+02	78.57942
26	3	114.00	102.00	.5600E+02	.2855E+03	-.2408E+03

				.4375E+03	-.9604E+02	-57.73683
26	4	114.00	102.00	-.5822E+01 .2162E+03	.2162E+03 -.5849E+01	.2475E+01 89.36127
27	1	114.00	111.00	-.1613E+03 -.1186E+03	-.1487E+04 -.1530E+04	.2418E+03 10.02119
27	2	114.00	111.00	-.3414E+03 .3082E+03	.4577E+02 -.6039E+03	.4129E+03 57.55812
27	3	114.00	111.00	.4648E+03 .1514E+04	.1098E+04 .4882E+02	-.6607E+03 -[illegible]7.80450
27	4	114.00	111.00	-.8503E+02 .2071E+03	.1947E+03 -.9743E+02	.6020E+02 78.35789
28	1	112.50	117.00	-.8195E+02 -.1989E+01	-.1079E+04 -.1159E+04	.2935E+03 15.24109
28	2	112.50	117.00	-.9778E+03 .2166E+03	-.38[illegible]8E+03 -.1581E+04	.8490E+03 54.59519
28	3	112.50	117.00	.1111E+04 .2319E+04	.1290E+04 .8212E+02	-.1115E+04 -47.29124
28	4	112.50	117.00	-.4693E+03 .9981E+02	-.5279E+01 -.5744E+03	.2446E+03 66.74673
29	1	111.00	126.00	.4424E+02 .1466E+03	-.6695E+03 -.7718E+03	.2890E+03 19.50311
29	2	111.00	126.00	-.8234E+03 .2024E+03	-.6629E+02 -.1092E+04	.5250E+03 62.89692
29	3	111.00	126.00	.7617E+03 .1355E+04	.6225E+03 .2958E+02	-.6588E+03 -41.98430
29	4	111.00	126.00	-.6771E+03 .3762E+01	.3606E+01 -.6772E+03	.1030E+02 89.13294
30	1	105.00	138.00	.4230E+02 .9758E+02	-.3789E+03 -.4342E+03	.1623E+03 18.81027
30	2	105.00	138.00	-.2554E+03 .6492E+03	-.1660E+03 -.1071E+04	.8587E+03 46.48881
30	3	105.00	138.00	.6904E+02 .1161E+04	.4980E+03 -.5945E+03	-.8514E+03 -52.06939
30	4	105.00	138.00	-.6755E+03 -.5715E+02	-.5726E+02 -.6756E+03	-.8179E+01 -89.24212
31	1	125.25	60.00	.3698E+02 .3700E+02	-.8282E+03 -.8282E+03	-.3737E+01 -.24745
31	2	125.25	60.00	-.2228E+02 .5580E+03	.5580E+03 -.2232E+02	-.5251E+01 -89.48158
31	3	125.25	60.00	-.2007E+03 .1175E+03	-.3412E+03 -.6595E+03	-.3821E+03 -39.79330
31	4	125.25	60.00	-.3434E+03 .1866E+02	-.4951E+01 -.3670E+03	-.9246E+02 -75.67440
32	1	125.25	78.00	-.1153E+03 -.1153E+03	-.9405E+03 -.9405E+03	-.4702E+01 -.32651
32	2	125.25	78.00	.9834E+02 .6278E+03	.6191E+03 .8965E+02	.6784E+02 82.69838
32	3	125.25	78.00	-.5030E+03 .1894E+03	-.3237E+03 -.1016E+04	-.5960E+03 -49.27665
32	4	125.25	78.00	-.2469E+03 .1141E+03	.2112E+02 -.3400E+03	-.1832E+03 -63.09151
33	1	125.25	90.00	-.1108E+03 -.1108E+03	-.1049E+04 -.1049E+04	.3413E+00 .02085
33	2	125.25	90.00	-.1364E+02 .6785E+03	.6322E+03 -.5995E+02	.1790E+03 75.49789
33		125.25	90.00	-.1550E+03 .5202E+03	-.1362E+03 -.8114E+03	-.6657E+03 -45.40471
33	4	125.25	90.00	-.1129E+03 .7352E+02	.4208E+02 -.1444E+03	-.7656E+02 -67.67484
34	1	125.25	102.00	-.1127E+03 -.1093E+03	-.1058E+04 -.1061E+04	.5654E+02 3.41125
34	2	125.25	102.00	-.2903E+03 .6573E+03	.5701E+03 -.3775E+03	.2875E+03 73.12304
34	3	125.25	102.00	.2498E+03 .8639E+03	.7808E+02 -.5350E+03	-.6947E+03 -41.47729
34	4	125.25	102.00	-.1237E+03 .5010E+02	.5008E+02 -.1237E+03	.2129E+01 89.29820
35	1	125.25	114.00	-.1155E+03 -.1126E+03	-.9766E+03 -.9795E+03	.4997E+02 3.30971
35	2	125.25	114.00	-.7134E+03 .7407E+03	.5759E+03 -.8782E+03	.4895E+03 71.39551
35	3	125.25	114.00	.6805E+03 .1222E+04	.2608E+03 -.2806E+03	-.7213E+03 -36.88896
35	4	125.25	114.00	-.2953E+03 .1065E+03	.5632E+02 -.3455E+03	.1419E+03 70.54279
36	1	125.25	132.00	.8532E+02 .8818E+02	-.8883E+03 -.8911E+03	.5283E+02 3.09718
36	2	125.25	132.00	-.6176E+03 .9209E+03	.7378E+03 -.8007E+03	.5308E+03 70.96546
36	3	125.25	132.00	.3548E+03 .8149E+03	.2330E+03 -.2271E+03	-.5175E+03 -41.64501
36	4	125.25	132.00	-.5345E+03 .6595E+02	.6360E+02 -.5368E+03	.3756E+02 86.42087

-------- STRESSES - TWO - D PLANE-STRESS MEMBERS ------ LOAD COMBINATIONS ----

LOAD LOAD CASE MULTIPLIERS

	1	2	3	4
	1.00	.59	.00	.00

ENT BER	LOAD COMB	Y-COORD	Z-COORD	SIGMA YY SIGMA 1	SIGMA ZZ SIGMA 2	SIGMA YZ THETA
1	1	60.75	60.00	.4814E+02 .4814E+02	-.1220E+04 -.1220E+04	.1036E+01 .04683
2	1	60.75	78.00	-.1831E+03 -.1812E+03	-.1374E+04 -.1376E+04	.4689E+02 2.25038
3	1	60.75	90.00	-.1110E+03 -.1029E+03	-.1496E+04 -.1504E+04	.1062E+03 4.35823
4	1	60.75	102.00	.5159E+02 .5951E+02	-.1469E+04 -.1477E+04	.1100E+03 4.11782
5	1	60.75	114.00	.3009E+03 .3336E+03	-.1386E+04 -.1419E+04	.2368E+03 7.84220
6	1	60.75	132.00	.4620E+03 .4993E+03	-.1389E+04 -.1427E+04	.2654E+03 8.00015
7	1	81.00	54.00	-.3156E+02 .5639E+02	-.4931E+03 -.5810E+03	.2198E+03 21.80490
8	1	75.00	66.00	-.6853E+02 .5464E+02	-.9019E+03 -.1025E+04	.3432E+03 19.74035
9	1	73.50	75.00	-.2201E+03 -.8471E+02	-.1505E+04 -.1640E+04	.4384E+03 17.15515
10	1	72.00	81.00	-.2348E+03 -.1767E+03	-.2067E+04 -.2125E+04	.3315E+03 9.94635
11	1	72.00	90.00	-.3704E+02 -.3364E+02	-.1760E+04 -.1763E+04	.7657E+02 2.54008
12	1	72.00	102.00	-.8503E+01 -.8500E+01	-.1636E+04 -.1636E+04	-.2405E+01 -.08465
13	1	72.00	111.00	.3052E+02 .3063E+02	-.1614E+04 -.1614E+04	-.1323E+02 -.46095
14	1	73.50	117.00	.4890E+03 .5141E+03	-.9229E+03 -.9480E+03	.1899E+03 7.52771
15	1	75.00	126.00	.5336E+03 .5336E+03	-.6736E+03 -.6737E+03	.6759E+01 .32077
16	1	81.00	138.00	.1984E+03 .3688E+03	-.3042E+03 -.4746E+03	.3386E+03 26.70915
17	1	87.00	66.00	.5891E+02 .1157E+03	-.2825E+03 -.3393E+03	.1503E+03 20.68211
18	1	87.00	126.00	.4354E+03 .5805E+03	-.7491E+02 -.2200E+03	.3083E+03 25.19453
19	1	99.00	66.00	.1419E+03 .1428E+03	-.9365E+02 -.9452E+02	-.1429E+02 -3.45918
20	1	99.00	126.00	-.4998E+02 .3221E+03	-.3541E+03 -.7262E+03	.5016E+03 36.56733
21	1	105.00	54.00	-.4591E+02 -.3108E+02	-.1944E+03 -.2092E+03	-.4922E+02 -16.77022
22	1	111.00	66.00	.5298E+02 .1027E+03	-.3675E+03 -.4172E+03	-.1529E+03 -18.01707
23	1	112.50	75.00	.3377E+02 .5025E+02	-.5594E+03 -.5759E+03	-.1002E+03 -9.33629
24	1	114.00	81.00	-.6631E+02 -.5460E+02	-.8215E+03 -.8332E+03	-.9477E+02 -7.04496
25	1	114.00	90.00	-.1759E+02 -.1742E+02	-.7868E+03 -.7870E+03	-.1139E+02 -.84787
26	1	114.00	102.00	-.5147E+02 -.3424E+02	-.9800E+03 -.9972E+03	.1277E+03 7.68721
27	1	114.00	111.00	-.3620E+03 -.1787E+03	-.1460E+04 -.1643E+04	.4846E+03 20.71769
28	1	112.50	117.00	-.6569E+03 -.1251E+03	-.1307E+04 -.1838E+04	.7926E+03 33.85853
29	1	111.00	126.00	-.4399E+03 .3845E+02	-.7084E+03 -.1187E+04	.5977E+03 38.67001
30	1	105.00	138.00	-.1079E+03 .4000E+03	-.4765E+03 -.9844E+03	.6672E+03 37.27829
31	1	125.25	60.00	.2388E+02 .2397E+02	-.5001E+03 -.5002E+03	-.6824E+01 -.74604
32	1	125.25	78.00	-.5753E+02 -.5515E+02	-.5764E+03 -.5788E+03	.3519E+02 3.86194
33	1	125.25	90.00	-.1188E+03 -.9949E+02	-.6769E+03 -.6962E+03	.1056E+03 10.36463
34	1	125.25	102.00	-.2834E+03 -.1881E+03	-.7225E+03 -.8178E+03	.2256E+03 22.88515
35	1	125.25	114.00	-.5350E+03 -.2448E+03	-.6380E+03 -.9282E+03	.3378E+03 40.66469
36	1	125.25	132.00	-.2778E+03 .9352E+01	-.4544E+03 -.7416E+03	.3649E+03 38.19798

LOAD COMB	LOAD CASE MULTIPLIERS 1	 2	 3	 4
2	1.00	.00	.59	.00

ELEMENT NUMBER	LOAD COMB	Y-COORD	Z-COORD	SIGMA YY SIGMA 1	SIGMA ZZ SIGMA 2	SIGMA YZ THETA
1	2	60.75	60.00	.1654E+03 .2226E+03	-.6631E+03 -.7204E+03	-.2252E+03 -14.26770
2	2	60.75	78.00	.1831E+03 .2963E+03	-.7906E+03 -.9038E+03	-.3507E+03 -17.88163
3	2	60.75	90.00	-.1978E+02 .1163E+03	-.1014E+04 -.1150E+04	-.3922E+03 -19.13773

4	2	60.75	102.00	-.2608E+03 -.6214E+02	-.1150E+04 -.1348E+04	-.4648E+03 -23.14407
5	2	60.75	114.00	-.5184E+03 -.2721E+03	-.1171E+04 -.1417E+04	-.4705E+03 -27.63203
6	2	60.75	132.00	-.1321E+03 -.1463E+02	-.1059E+04 -.1176E+04	-.3502E+03 -18.54513
7	2	81.00	54.00	-.2969E+02 .1923E+03	-.6088E+02 -.2828E+03	-.2370E+03 -43.11755
8	2	75.00	66.00	.3255E+03 .3342E+03	-.2611E+03 -.2698E+03	-.7188E+02 -6.88464
9	2	73.50	75.00	.4392E+03 .5397E+03	-.2774E+03 -.3779E+03	-.2866E+03 -19.32599
10	2	72.00	81.00	.8420E+02 .1058E+03	-.7208E+03 -.7424E+03	-.1337E+03 -9.18946
11	2	72.00	90.00	.1216E+01 .8538E+01	-.9926E+03 -.9999E+03	-.8562E+02 -4.88796
12	2	72.00	102.00	-.6284E+02 -.3377E+02	-.1489E+04 -.1518E+04	-.2057E+03 -8.04500
13	2	72.00	111.00	-.4395E+03 -.2327E+03	-.2195E+04 -.2402E+04	-.6370E+03 -17.98492
14	2	73.50	117.00	-.7386E+03 -.1949E+03	-.1880E+04 -.2423E+04	-.9570E+03 -29.60100
15	2	75.00	126.00	-.4114E+03 .1947E+02	-.1061E+04 -.1491E+04	-.6822E+03 -32.27842
16	2	81.00	138.00	-.1910E+02 .3922E+03	-.6812E+03 -.1093E+04	-.6644E+03 -31.75694
17	2	87.00	66.00	.3044E+03 .4551E+03	.3973E+02 -.1110E+03	-.2502E+03 -31.06283
18	2	87.00	126.00	-.6716E+02 .2903E+03	-.4634E+03 -.8208E+03	-.5190E+03 -34.55290
19	2	99.00	66.00	-.8480E+02 .1950E+03	-.4080E+03 -.6878E+03	-.4108E+03 -34.26174
20	2	99.00	126.00	.4371E+03 .6216E+03	.3963E+02 -.1450E+03	-.3278E+03 -29.38622
21	2	105.00	54.00	-.3007E+02 .2576E+03	-.6134E+03 -.9010E+03	-.5005E+03 -29.88593
22	2	111.00	66.00	-.3232E+03 -.5984E+01	-.9884E+03 -.1306E+04	-.5582E+03 -29.60659
23	2	112.50	75.00	-.6100E+03 -.1913E+03	-.1756E+04 -.2175E+04	-.8095E+03 -27.35100
24	2	114.00	81.00	-.3780E+03 -.2191E+03	-.2132E+04 -.2291E+04	-.5513E+03 -16.07500
25	2	114.00	90.00	-.5474E+02 -.3487E+02	-.1525E+04 -.1545E+04	-.1720E+03 -6.58651
26	2	114.00	102.00	.3828E+01 .9407E+01	-.1096E+04 -.1102E+04	-.7855E+02 -4.06289
27	2	114.00	111.00	.1120E+03 .1341E+03	-.8412E+03 -.8633E+03	-.1467E+03 -8.55394
28	2	112.50	117.00	.5714E+03 .6998E+03	-.3206E+03 -.4491E+03	-.3620E+03 -19.53275
29	2	111.00	126.00	.4921E+03 .5041E+03	-.3035E+03 -.3154E+03	-.9835E+02 -6.94411
30	2	105.00	138.00	.8289E+02 .3471E+03	-.8608E+02 -.3503E+03	-.3383E+03 -37.98874
31	2	125.25	60.00	-.8106E+02 -.2888E+02	-.1029E+04 -.1081E+04	-.2284E+03 -12.86710
32	2	125.25	78.00	-.4111E+03 -.2654E+03	-.1131E+04 -.1277E+04	-.3552E+03 -22.31226
33	2	125.25	90.00	-.2019E+03 -.5895E+02	-.1129E+04 -.1272E+04	-.3911E+03 -20.08160
34	2	125.25	102.00	.3418E+02 .1416E+03	-.1012E+04 -.1119E+04	-.3519E+03 -16.96764
35	2	125.25	114.00	.2847E+03 .3992E+03	-.8233E+03 -.9378E+03	-.3742E+03 -17.01798
36	2	125.25	132.00	.2939E+03 .3513E+03	-.7513E+03 -.8086E+03	-.2514E+03 -12.84666

LOAD COMB	LOAD CASE MULTIPLIERS 1	2	3	4
3	1.00	1.00	1.00	.00

ELEMENT NUMBER	LOAD COMB	Y-COORD	Z-COORD	SIGMA YY SIGMA 1	SIGMA ZZ SIGMA 2	SIGMA YZ THETA
1	3	60.75	60.00	.2688E+03 .3615E+03	-.1211E+04 -.1304E+04	-.3818E+03 -13.64705
2	3	60.75	78.00	.2684E+03 .4155E+03	-.1420E+04 -.1567E+04	-.5195E+03 -15.80489
3	3	60.75	90.00	.3866E+02 .1602E+03	-.1746E+04 -.1867E+04	-.4814E+03 -14.17394
4	3	60.75	102.00	-.8865E+02 .2410E+02	-.1907E+04 -.2020E+04	-.4666E+03 -13.58488
5	3	60.75	114.00	-.9662E+02 -.5606E+02	-.1997E+04 -.2038E+04	-.2806E+03 -8.22566
6	3	60.75	132.00	.3530E+03 .3532E+03	-.2025E+04 -.2025E+04	-.2170E+02 -.52280
7	3	81.00	54.00	-.2505E+02 .2527E+03	-.1504E+03 -.4281E+03	-.3346E+03 -39.69575
8	3	75.00	66.00	.4393E+03 .4513E+03	-.5101E+03 -.5221E+03	-.1072E+03 -6.36322

9	3	73.50	75.00	.5739E+03 .6696E+03	-.6438E+03 -.7394E+03	-.3544E+03 -15.10165
10	3	72.00	81.00	.8836E+02 .1039E+03	-.1391E+04 -.1406E+04	-.1523E+03 -5.81734
11	3	72.00	90.00	.1880E+01 .9605E+01	-.1721E+04 -.1728E+04	-.1156E+03 -3.82269
12	3	72.00	102.00	-.5161E+02 -.3328E+02	-.2270E+04 -.2288E+04	-.2025E+03 -5.17294
13	3	72.00	111.00	-.3091E+03 -.2064E+03	-.2898E+04 -.3001E+04	-.5258E+03 -11.05355
14	3	73.50	117.00	-.2316E+03 -.5959E+02	-.2171E+04 -.2343E+04	-.6027E+03 -15.93382
15	3	75.00	126.00	.9768E+02 .2306E+03	-.1339E+04 -.1472E+04	-.4568E+03 -16.22583
16	3	81.00	138.00	.2022E+03 .2306E+03	-.7657E+03 -.7941E+03	-.1682E+03 -9.58344
17	3	87.00	66.00	.3694E+03 .5905E+03	.1904E+02 -.2021E+03	-.3554E+03 -31.88193
18	3	87.00	126.00	.1717E+03 .2004E+03	-.4142E+03 -.4429E+03	-.1329E+03 -12.20445
19	3	99.00	66.00	-.1469E+03 .2646E+03	-.4179E+03 -.8294E+03	-.5300E+03 -37.82891
20	3	99.00	126.00	.2053E+03 .2231E+03	-.3332E+02 -.5110E+02	.6752E+02 14.75039
21	3	105.00	54.00	-.4851E+02 .3609E+03	-.5787E+03 -.9880E+03	-.6202E+03 -33.42861
22	3	111.00	66.00	-.4485E+03 .2069E+02	-.8356E+03 -.1305E+04	-.6339E+03 -36.50975
23	3	112.50	75.00	-.7675E+03 -.1538E+03	-.1545E+04 -.2159E+04	-.9241E+03 -33.58838
24	3	114.00	81.00	-.4070E+03 -.1646E+03	-.1673E+04 -.1916E+04	-.6047E+03 -21.84352
25	3	114.00	90.00	-.5965E+02 -.1389E+02	-.9775E+03 -.1023E+04	-.2100E+03 -12.29269
26	3	114.00	102.00	-.1115E+02 -.1799E+01	-.4953E+03 -.5047E+03	-.6793E+02 -7.83700
27	3	114.00	111.00	-.3787E+02 -.3775E+02	-.3430E+03 -.3431E+03	-.5972E+01 -1.12085
28	3	112.50	117.00	.5138E+02 .5469E+02	-.1761E+03 -.1794E+03	.2765E+02 6.83216
29	3	111.00	126.00	-.1746E+02 .9705E+02	-.1133E+03 -.2278E+03	.1552E+03 36.42136
30	3	105.00	138.00	-.1440E+03 .8095E+02	-.4697E+02 -.2720E+03	.1697E+03 52.98252
31	3	125.25	60.00	-.1860E+03 .4646E+02	-.6114E+03 -.8439E+03	-.3911E+03 -30.73109
32	3	125.25	78.00	-.5200E+03 -.4601E+02	-.6451E+03 -.1119E+04	-.5329E+03 -41.65389
33	3	125.25	90.00	-.2794E+03 .8912E+02	-.5526E+03 -.9212E+03	-.4863E+03 -37.15518
34	3	125.25	102.00	-.1532E+03 .9197E+02	-.4096E+03 -.6547E+03	-.3506E+03 -34.95790
35	3	125.25	114.00	-.1484E+03 .3776E+02	-.1399E+03 -.3261E+03	-.1819E+03 -45.66596
36	3	125.25	132.00	-.1775E+03 .9844E+02	.8257E+02 -.1933E+03	.6616E+02 76.51489

LOAD COMB	LOAD CASE MULTIPLIERS 1	2	3	4
4	1.00	.00	1.00	1.00

ELEMENT NUMBER	LOAD COMB	Y-COORD	Z-COORD	SIGMA YY SIGMA 1	SIGMA ZZ SIGMA 2	SIGMA YZ THETA
1	4	60.75	60.00	-.9464E+02 .4154E+02	-.5502E+03 -.6863E+03	-.2839E+03 -25.62960
2	4	60.75	78.00	.1356E+03 .3073E+03	-.6611E+03 -.8328E+03	-.4077E+03 -22.83155
3	4	60.75	90.00	-.7436E+02 .2209E+03	-.9428E+03 -.1238E+04	-.5862E+03 -26.73586
4	4	60.75	102.00	-.4917E+03 -.2146E+01	-.1158E+04 -.1648E+04	-.7523E+03 -33.05476
5	4	60.75	114.00	-.1100E+04 -.2593E+03	-.1246E+04 -.2086E+04	-.9105E+03 -42.71421
6	4	60.75	132.00	-.8216E+03 -.3485E+03	-.1110E+04 -.1583E+04	-.6003E+03 -38.24697
7	4	81.00	54.00	-.4261E+03 .2957E+03	.3209E+01 -.7186E+03	-.4595E+03 -57.51915
8	4	75.00	66.00	.6182E+02 .2151E+03	-.8156E+02 -.2349E+03	-.2133E+03 -35.71030
9	4	73.50	75.00	.3980E+03 .6792E+03	.1140E+03 -.1673E+03	-.3987E+03 -35.19856
10	4	72.00	81.00	.1462E+03 .2895E+03	-.1860E+03 -.3293E+03	-.2610E+03 -28.76753
11	4	72.00	90.00	.1105E+02 .3862E+02	-.6541E+03 -.6817E+03	-.1382E+03 -11.28271
12	4	72.00	102.00	-.9248E+02 -.2444E+02	-.1421E+04 -.1490E+04	-.3083E+03 -12.44513
13	4	72.00	111.00	-.7204E+03 -.2882E+03	-.2487E+04 -.2919E+04	-.9749E+03 -23.90892

14	4	73.50	117.00	-.1672E+04 -.3437E+03	-.2442E+04 -.3770E+04	-.1669E+04 -38.50536
15	4	75.00	126.00	-.1411E+04 -.3991E+03	-.1329E+04 -.2341E+04	-.9702E+03 -46.21836
16	4	81.00	138.00	-.7387E+03 .1729E+03	-.9501E+03 -.1862E+04	-.1012E+04 -42.01748
17	4	87.00	66.00	-.1927E+03 .3948E+03	.9978E+02 -.4878E+03	-.4163E+03 -54.67841
18	4	87.00	126.00	-.1145E+04 -.3419E+02	-.7047E+03 -.1815E+04	-.8629E+03 -52.15214
19	4	99.00	66.00	-.8498E+03 -.4774E+02	-.6582E+03 -.1460E+04	-.6998E+03 -48.89788
20	4	99.00	126.00	-.2856E+03 .5523E+03	.1511E+03 -.6868E+03	-.5798E+03 -55.31809
21	4	105.00	54.00	-.4246E+03 .1457E+03	-.9327E+03 -.1503E+04	-.7842E+03 -36.02484
22	4	111.00	66.00	-.1032E+04 -.3110E+03	-.1316E+04 -.2036E+04	-.8508E+03 -40.26183
23	4	112.50	75.00	-.1374E+04 -.3436E+03	-.2395E+04 -.3426E+04	-.1454E+04 -35.32747
24	4	114.00	81.00	-.6354E+03 -.2849E+03	-.2587E+04 -.2938E+04	-.8983E+03 -21.31541
25	4	114.00	90.00	-.8352E+02 -.2575E+02	-.1566E+04 -.1623E+04	-.2983E+03 -10.96262
26	4	114.00	102.00	.2108E+02 .5850E+02	-.7627E+03 -.8001E+03	-.1753E+03 -12.05066
27	4	114.00	111.00	.2185E+03 .4260E+03	-.1940E+03 -.4015E+03	-.3587E+03 -30.05109
28	4	112.50	117.00	.5598E+03 .9860E+03	.2055E+03 -.2207E+03	-.5767E+03 -36.46142
29	4	111.00	126.00	.1289E+03 .4124E+03	-.4339E+02 -.3269E+03	-.3595E+03 -38.26326
30	4	105.00	138.00	-.5641E+03 .5131E+03	.6181E+02 -.1015E+04	-.6972E+03 -57.08727
31	4	125.25	60.00	-.5072E+03 -.2576E+03	-.1174E+04 -.1424E+04	-.4783E+03 -27.55345
32	4	125.25	78.00	-.8653E+03 -.2478E+03	-.1243E+04 -.1861E+04	-.7840E+03 -38.22672
33	4	125.25	90.00	-.3787E+03 .7377E+02	-.1143E+04 -.1595E+04	-.7419E+03 -31.37787
34	4	125.25	102.00	.1342E+02 .3336E+03	-.9296E+03 -.1250E+04	-.6360E+03 -26.72362
35	4	125.25	114.00	.2697E+03 .5095E+03	-.6595E+03 -.8993E+03	-.5294E+03 -24.36459
36.	4	125.25	132.00	-.9438E+02 .1512E+03	-.5916E+03 -.8372E+03	-.4271E+03 -29.89637

END OF RESULTS PRODUCED FROM INPUT FILE "wall2 "

END OF RESULTS PRODUCED FROM INPUT FILE "