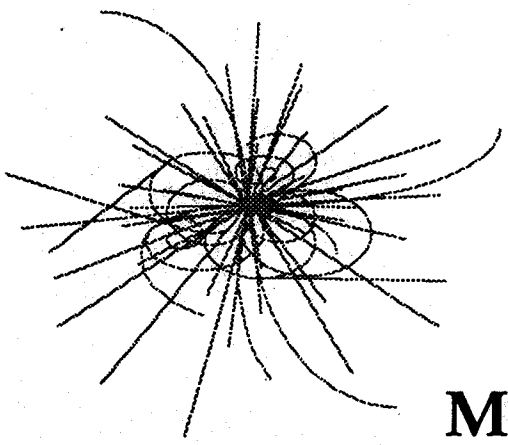
SDC 91-121



Monthly Report of the Solenoidal Detector Collaboration

October 1991

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MONTHLY REPORT
OF THE
SOLENOIDAL DETECTOR COLLABORATION

OCTOBER 1991

REPORT SUMMARY

1. OAK RIDGE NATIONAL LABORATORY (ORNL)

2. PHYSICAL SCIENCES LABORATORY (PSL) - MUON

Design and cost issues were evaluated for different muon chambers. A one meter prototype chamber was assembled and evaluated. A preliminary design report is being prepared for the barrel toroid.

3. PHYSICAL SCIENCES LABORATORY (PSL) - TRIGGER

Studies of the design of a calorimeter isolated electron Level-1 trigger are in progress. A cost analysis of the SDC trigger system has been produced and a new design of the clock and control distribution system has been prepared.

4. FERMI NATIONAL LABORATORY (FNAL)

Quench behavior studies for the full size solenoid continued. Various cold mass support system configurations are being evaluated. The calorimetry group focused on developing cost data to aid in design choices. ANSYS analysis of muon support systems are underway.

5. ARGONNE NATIONAL LABORATORY (ANL)

Work on the Lead Scintillator plate calorimeter focused on optical fiber routing and intermodule space allocation to fibers. 3D models of the end-cap and barrel are being analyzed. Efforts are continuing for instrumenting modules in the FNAL test beam.

6. WESTINGHOUSE (WSTC)

7. UNIVERSITY OF MICHIGAN

Efforts on triggering with superlayers of straw tubes focused on the conceptual design reports for both straw and muon triggering. Modules utilizing first generation Application Specific Integrated Circuits are being prepared for tests.

8. LOS ALAMOS NATIONAL LABORATORY (LANL)

Efforts were directed towards completion of a Conceptual Design Review document, and the preparation of cost and schedule estimates for FY92.

9. ICF KAISER ENGINEERS (KE)

A final report was submitted on detector installation and assembly methods and procedures.

10. LAWRENCE BERKELEY LABORATORY

The final SDC base-line cost roll-up was completed. Modifications of the silicon tracking modules were evaluated to improve thermal and structural performance.

A. TECHNICAL PROGRESS

1. OAK RIDGE NATIONAL LABORATORY (ORNL)

(No report available for this month.)

2. UNIVERSITY OF WISCONSIN PHYSICAL SCIENCES LABORATORY (PSL) - MUON SYSTEM

Muon System

Design and cost issues were presented to the muon barrel chamber group to be used in evaluating and comparing chamber designs. Issues of mounting and alignment were also discussed and options are under investigation. The present plan is to make monolithic structures of each of the three BW1, BW2 and BW3 chamber stations. Under this plan, the monoliths can be mounted on four points and all wire locations within them are known with respect to reference points. Mechanical tests and calculations on these large structures are underway. A variation on the endplate design is being studied. The new endplate would be an extrusion with steps and an internal gas path. (See Figures 2-1 and 2-2.) This idea could reduce dead space at the corners and make the gas distribution system simpler and more reliable. The feasibility of making this extrusion is under investigation.

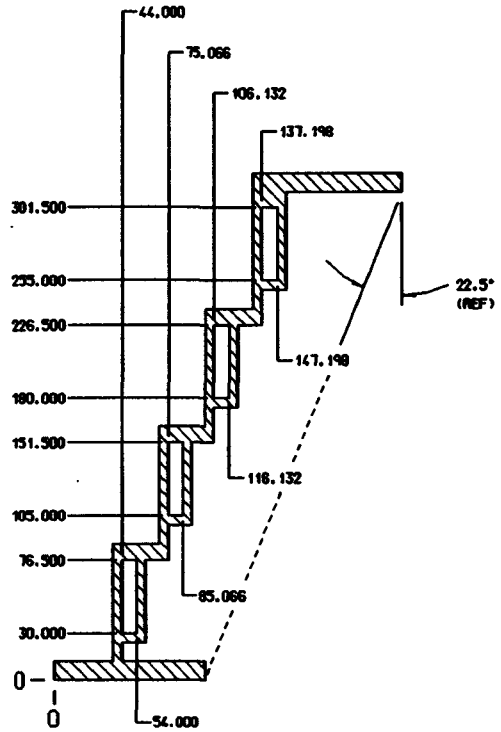
Muon Chamber Prototype

All parts for one 16-cell (1- meter long) prototype and one 32-cell (9.5 meter) prototype were fabricated. The 16-cell prototype was assembled with wires. This prototype was used to measure wire end locations with respect to a known position on the chamber endplates. The wire position accuracy for this prototype is within the desired 100 micrometers. A test for gas distribution within a chamber was conducted and a preliminary circuit has been derived. An alternative wire mounting and gas distribution system was investigated. This alternative promises better wire location accuracy through the elimination of an intermediate piece. A test was conducted to determine the thermal conductance of the chamber assembly in a direction perpendicular to the wires. This test will aid in determination of the maximum temperature difference that can exist across the thickness of a chamber. Tests on wire yield and breaking strength were performed. Long term creep properties of the wire and the wire mounting pieces are under study. The field of the bending magnet for the cosmic ray test was mapped. The installation and final survey of the assembly and gluing station for the long prototype were completed.

Preliminary Toroid Design (Coils)

Partial responsibility for the design work on the Muon Barrel Toroid (MBT) and support system has been transferred back to UW-PSL. An outline for the Preliminary Design Report has been prepared. This outline was used to prepare a task list. Work assignments and a schedule are being generated. Most of the work in October centered on the Z connections. Side plates, long cables, and bolts have been investigated. There are two new ideas on how to incorporate Z plates into the assembly that will be investigated. The shear and moment requirements for the Z connections are also under study. Wedge jacks

are being considered as an alternative to hydraulics. Preliminary calculations and contact with wedge jack vendors were positive, so there will be more work in this area. UW-PSL reviewed modeling work on the MBT at SSCL and the support system at FNAL and made suggestions for changes to the design. There has been no work on the coils this month due to the steel and integration work.



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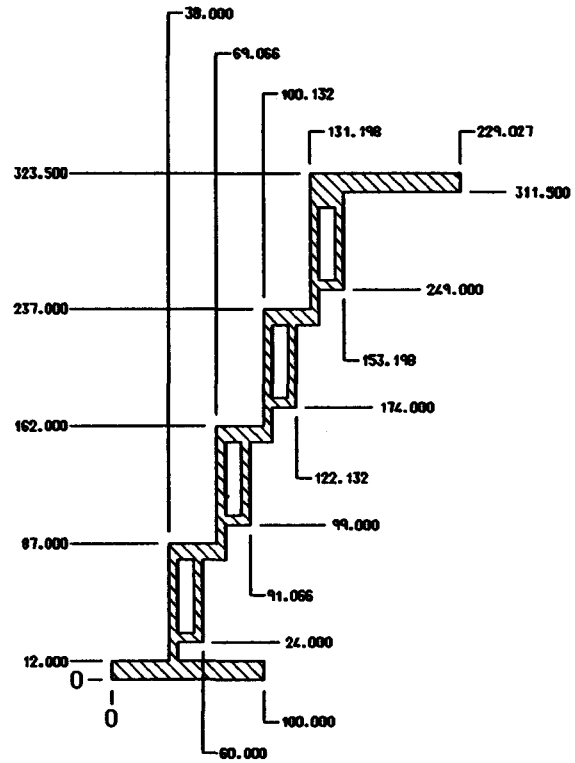

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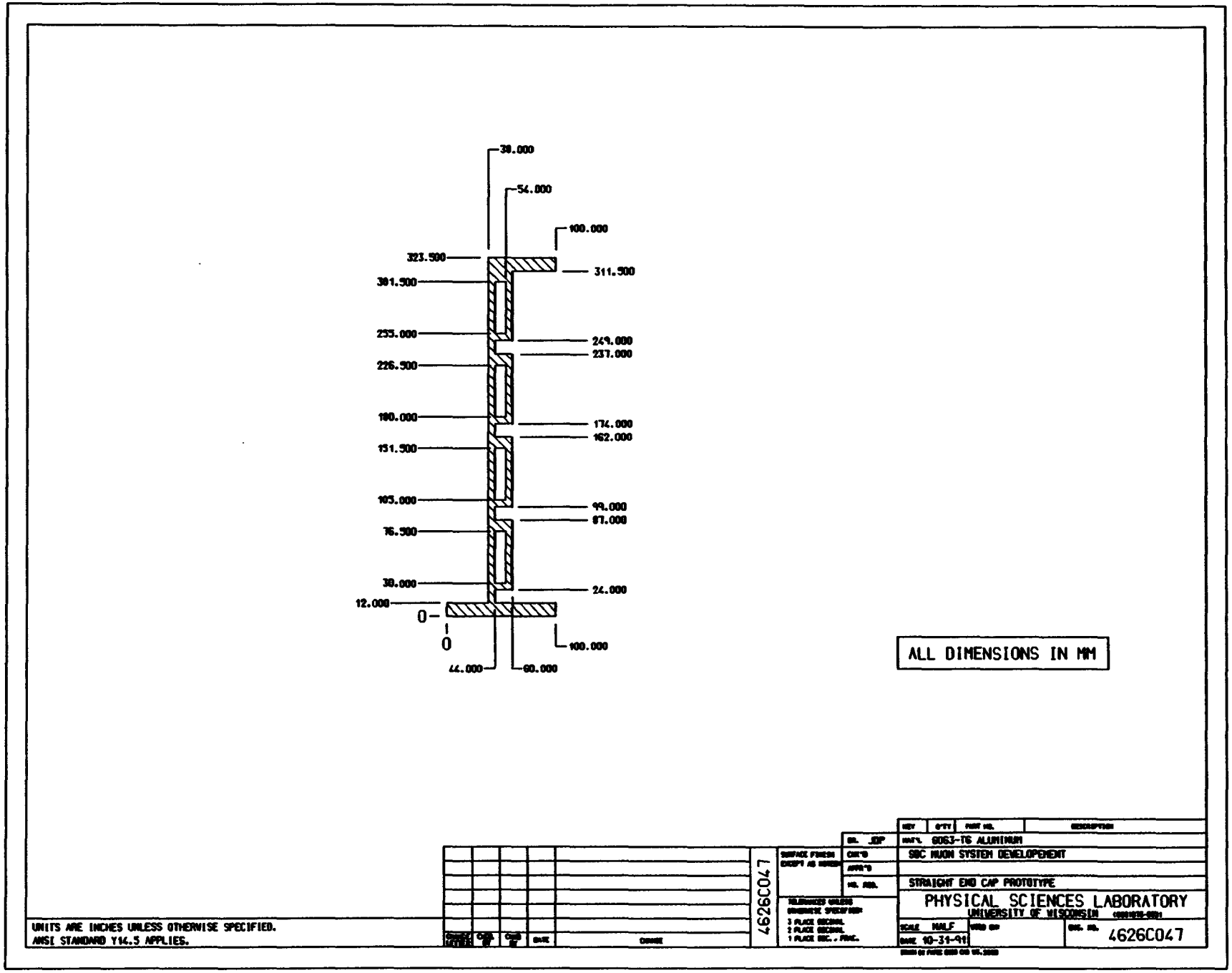

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Figure 2-2

3. UNIVERSITY OF WISCONSIN PHYSICAL SCIENCES LABORATORY (PSL) - TRIGGER SYSTEMS

Calorimeter Level 1 Trigger

Design studies for a calorimeter isolated electron Level 1 trigger[1] have continued. Photomultiplier Tube (PMT) currents for the EMC and HAC sections of each trigger tower are fed through a preamp and digitized in a FADC to produce a value for the current. We have designed and tested such a preamp[2] and are preparing to test 20 production surface-mount technology printed circuit boards being manufactured for use in a beam test.

In order to simulate the performance of the electron trigger logic, 20000 Drell-Yan W's, 20000 Drell-Yan Zs, 120,000 QCD two jet events from 20-200 GeV, and minbias events corresponding to a poisson distribution with mean 1.6 events per crossing were generated. The events were integrated over three beam crossings, using a scintillator calorimeter shaping function from ZEUS.

The calorimeter level 1 trigger electronics was then simulated in detail to determine how many events the proposed trigger would find. The simulation was run on Symmetric MultiProcessor Silicon Graphics Inc. 4D/380s at the Physics Detector Simulation Facility of the SSC Laboratory. We included the effect on the trigger of an ideal tracker, assuming the tracker finds all particles with some error in momentum measurement.

A 50% W efficiency was achieved with a QCD background of 1.4 kHz using 24GeV and 36 GeV thresholds in the central and end cap regions respectively. For Z events, a 91% two-electron efficiency was achieved with a background rate of 13 Hz by using thresholds of 12 GeV and 14 GeV.

Trigger System Engineering

We have continued development of the preliminary conceptual design of the SDC trigger system[3]. A draft of a new cost analysis based on this design has been produced[4]. This includes an analysis of base cost and contingency.

The SDC trigger system costed is based on a particular implementation of the SDC trigger group conceptual design report [5]. The design is described in [3] and

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[1] T. Gorski, J. Lackey, W.H. Smith, W. Temple, *Isolated Electron Pattern Logic Design and Performance at the SSC*, U. Wisconsin SDC Note SDC-91-00087, 1991.

[2] D. Panescu, J. Lackey, P. Robl, W.H. Smith, *An SSC PMT Preamplifier Circuit*, U. Wisconsin SDC Note SDC-91-00086, 1991.

[3] W. H. Smith, T. Gorski, J. Lackey, *SDC Trigger Preliminary Conceptual Design*, U. Wisconsin SDC Note SDC-91-00089, 1991.

[4] W. H. Smith, R. Craven, T. Gorski, J. Lackey, J. LeBeck, *SDC Trigger Cost*, U. Wisconsin, SDC Note SDC-91-00091, 1991.

[5] A. Lankford et al., *Conceptual Design of the SDC Trigger from the SDC Trigger Group*, SDC Note SDC-91-00098, 1991.

has several subsystems. These include the Level 1 Decision Logic[6], the Level 2 Decision Logic[3] and the Trigger Clock and Control System[7]. The basic Level 1 Trigger system interfaces to front-end electronics crates on the detector for the calorimeter, shower max, tracking and muon subsystems. These are connected with optical fibers[8] to the counting house on the surface, which contains the level 1 decision processing crates. These include the Calorimeter Isolation/Summation crates, the Track/Shower Max Match crates, the Isolated Electron Match crates, the Energy Sum/Jet Threshold crate, the Muon Trigger Crates, and Final Decision crate.

Trigger Clock/Control

There is a new design of the clock and control distribution and generation. This new design results in a trigger system that is "partitionable" in a similar manner to the DAQ system. Generally, clock and control distribution parallels the DAQ processor control distribution and is closely linked to it.

Each subsystem crate in the detector is linked to the Level 1 Clock and Control system through 3 basic connections as represented by the following 3 logical cable types: the Clock, Control, and Status cables. The Clock cable distributes the 16ns crossing clock to the subsystem crate, the Control cable distributes Level 1 trigger information, and the Status cable returns Level 1 status information from the subsystem crate to the Clock and Control system. The Control and Status cables are required to carry a 16-bit Control or Status word for each 16ns crossing, thus having a data rate of 1 Gb/s.

The Level 1 Clock and Control distribution system consists of two basic crate types, the Global Clock and Control crate, and the Level 1 Distribution crate, which together distribute the crossing clock and control information to and receive status from all trigger and DAQ subsystem crates in the detector.

The Global Clock and Control crate uses the output from the Final Decision crate, along with machine clock and beam pickup information, plus operator control through the DAQ processor system to generate the root Clock and Control cable output. These signals are sent to up to 16 nearby Level 1 Distribution crates, which in turn can rebroadcast the Clock and Control cable signals to up to 64 subsystem crates each.

The Status cables from the subsystem crates to the Global Clock and Control crate follow the same path, in the reverse direction. Each Level 1 Distribution crate consolidates the status of up to 64 subsystem crates, and transmits that on a Status cable to the Global Clock and Control crate. Every front end electronics crate, as well as every trigger system crate has a Level 1 Clock and Control Board (L1CCB).

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[6]T. Gorski, J. Lackey, W.H. Smith, *Level 1 Trigger Decision Design for the SDC*, U. Wisconsin SDC Note SDC-91-00088, 1991.

[7]W. H. Smith, T. Gorski, J. Lackey, *SDC Global Level 1 Processor: Clock & Control*, U. Wisconsin SDC Note SDC-91-00090, 1991.

[8]M. Thompson, *Fiber Optic Data Transmission for the SDC Detector*, U. Wisconsin SDC Note SDC-91-00092, 1991.

The purpose of the L1CCB is to receive the machine clock and Level 1 trigger informations on Clock and Control cables via the frontpanel and rebroadcast this information to L1CCF or subsystem electronics cards across four identical backplane busses. Simultaneously, it is receiving and consolidating subsystem status information from these cards and transmitting it upwards on the Status cable connection on the frontpanel. The Level 1 Clock and Control Fanout (L1CCF) card is used in the Global Clock and Control and Level 1 Distribution crates to perform the fanout/ fanin functions on the Clock, Control, and Status cables. It provides the link between the L1CCB residing in current crate and the L1CCBs in the next level of crates below. The L1CCF accesses the four backplane fanout/fanin ports provided by the L1CCB, and provides an additional 1-to-4 fanout and 4-to-1 fanin to four Clock, Control, and Status cable interfaces on the frontpanel.

The Level 1 Simulation Module (L1SM) emulates all of the above control sequences described above for the Level 1 Clock and Control System. Its purpose is to aid in the debugging of Subsystem DAQ and trigger circuits, and to serve the basic functions of a trigger module for test experiments.

The L1SM has a subset of the functionality of a L1CCB. Basically, it operates as an L1CCB in standalone emulator mode. It has no frontpanel connections for Clock, Control or Status cables. Further, it does not provide a 4X fanout/fanin capability. Instead, the L1SM interfaces to a single Control/Status cable port on the backplane.

4. FERMILAB (FNAL)

SUPERCONDUCTING SOLENOID

Cryogenics

Calculations continued to determine the helium relieving rate from the cooling tube on the support cylinder and the peak pressure generated in the cooling tube during a quench of the full-size solenoid. Specifically, we estimated the current decay in the solenoid for a quench with quench-back effects included. This case may possibly generate a helium relieving rate and peak pressure which are greater than the results of cases without quench-back. Current decay time constants for the quench-back case were obtained by analyzing CDF fast dump data. Also, calculations were initiated to estimate the pressure drop in the cooling tube as a function of length along the tube at the time the peak pressure occurs.

An evaluation of several locations for the chimney electrical connector box was started. This is a vacuum box which will house the electrical connectors for the instrumentation and the voltage taps from the solenoid.

Development work on the isogrid outer vacuum shell of the cryostat continues. NC machining of two isogrid test panels, using 2219-T351 aluminum alloy began. The engineering and design of the isogrid shell for the vacuum vessel to house the prototype superconducting coil was completed. We are negotiating several dimensions with KEK, who is responsible for the coil. A company in California which has vast experience in brake forming and welding of isogrid shells for aerospace applications was located. The aluminum material for the prototype shell will be purchased and contracts for the machining, forming, and welding will be written as soon as FY92 funds become available.

Cold Mass Supports

Work continues on the development of several cold mass support system configurations. These systems include the Warren truss dual function support, the Composite Wound Delta (CWD) dual function support, and a separated function support system that incorporates tensile/compressive metallic rods for the axial magnetic decentering forces and GFRP tension straps for the radial decentering forces. The goal of this effort is to make a comparison of the various supports based on function, physical size, reliability, heat leak, and radiation length. The design of the supports is based on 66 tonnes of axial decentering force and 60 tonnes (3 times cold mass) of radial decentering force. The maximum allowable stress for the metallic components is the lower of 2/3 minimum yield stress or 1/4 minimum ultimate stress. A safety factor of 2 on ultimate strength is assumed on composite components where reliability can be demonstrated by destructive testing of prototypes.

An analysis of a separated function support system based on the KEK layouts gives a maximum allowable tensile force per rod of 1600 lbs. This was based on the previously mentioned allowable stresses and safety factors. It was also assumed that all metallic components were aluminum 2219-T851. Using titanium or inconel for these components would increase the tensile capacity of these supports with some sacrifice in radiation length.

Magnetostatic and Other finite-Element Caluculations

The generic test models were re-run for a shorter coil and flux plots were created for the cases of -40, 0 and +40 cm re-entrant endplug configurations. Several other runs (about 9 in all) were made and field information extracted and sent to Alan Sill at the University of Rochester for tracking studies. The magnetostatic model of a 20 cm re-entrant iron/scintillator calorimeter design was created, and compressive coil forces and decentering coil forces calculated. A 3-d model of a pizza-pie calorimeter was created, but convergence problems were encountered, and activity has been suspended until more cp time becomes available.

The endring on the vacuum shell necessary to support a dedicated function CDF-style support system was analyzed, and it was found that the size shown on the Japanese drawings is adequate from both stress and buckling standpoints for the forces for which the supports appear to be designed.

A paper was written for submission to the journal CRYOGENICS; it deals with the current redistribution in the aluminum stabilizer of a superconductor after a quench. The paper is being reviewed internally.

We performed a finite-element analysis of the inner vacuum shell of the cryostat to answer the question, "Could someone walk on the inner shell of the installed cryostat?" We considered 1/4- and 3/8-inch shells, and found that for either the answer to the question was "Yes". The deflections are in the millimeter range and the accompanying stresses are well below the ASME Code allowable for aluminum.

CALORIMETRY ENGINEERING

Cost Estimating

The Calorimeter design group spent some time this month developing cost information which will be used to make the decision of what material to make HAC1 out of, lead or iron. We are assembling a report on the engineering and cost implications of the different materials which will be presented at the November collaboration meeting at the SSC. We went back to our earlier vendor quotes and modified the dollar values to reflect recent design changes and additions. (The original steel plate quote did not contain grooves for the readioactive source tubes used in calabrating tiles.) This effort should help to refine the cost deltas between the different options, leading to a more straight forward decision. We hope to reach agreement on the absorber material by the collaboration meeting so that final design can proceed.

FNAL "Model A" (Iron HAC) Design Work

At the first engineering/integration meeting at the SSCL, we presented the iron calorimeter design's impact on the access space around the calorimeter. At this meeting a number of space limitations and conflicts were brought to light forcing a redesign of the PMTs on the back of the calorimeter. At this meeting a decision was also taken to adopt the "picnic table" design done by the FNAL group. This design is for the rails which allow the calorimeter to roll into the muon steel and which have to attach to the bottom corners of the muon barrel steel. The design will be slightly modified to incorporate a man-walk so that people would not have to climb over the cross bracing as they walk down the length of the calorimeter.

This meeting also raised questions about alignment of the different detectors. This discussion prompted a look into a design of the calorimeter support structure to see if horizontal translation and yaw adjustment can be accomodated. The US vendors of grease pad assemblies are being questioned. Some quick sizing estimates determined that for a grease pad to fit in the space available it will need to operate in the 4000psi range. More product research is needed see if such uints are manufactured. If not, we will need to come up with a design for reducing the friction in the calorimeter support so that it can be pushed side-ways. Actuators of appropriate size will also have to be found.

A decision was to reject the design of the monolithic endcap in favor of a modular wedge-based design. We are now reviving the old wedge based drawings and examining options for a removable EM section and possibly a removable inner cone of hadron tiles at 5.7 degrees from the beam axis. These hadron tiles are probably as susceptible to damage as the EM tiles and may need a replacement scheme which is quicker and easier than disassembling the entire end cap.

Beam Test Work at FNAL

The hanging file test has been taking data for a while now and results of the viability of different absorber configurations will be presented at the November collaboration meeting. The Argonne EM block has also been running in the MP test beam, with some preliminary results already announced.

Work continued on the iron hadron block to mount in the MP beam line behind the ANL EM module. Our estimate now is for insertion into the beam line around November 18.

Data Acquisition System

Effort continued on artworking of the Tracking module, setting up for prototype tests, and beginning tests of the Test Transmitter module.

Much detail was added to the SDC DAQ Conceptual Design Document in October. Backup material was gathered from a commercial switching network company

Muon Support and Alignment

ANSYS analyses have begunof truss configurations with the intention of supporting the trusses at four locations instead of the previous ten locations. This should also make it possible to accommodate a one-piece BW1 supermodule (8m x 7m).

The functional setup of a prototype of a 3Khz wire current (0.2a)/ differential flux transformer position sensor system was completed. Utilizing a commercial LVDT circuit (Signetics NE5521n) in the system is being considered. Samples and a precision cross slide system for displacement linearity measurements are being sent. Building experimental tape wound square Permalloy pickup transformers is proceeding.

Work continues on the problems with the prototype Migatron RPS8800 Ultrasonic distance measuring system. On very long (1.75m) transmission paths in open air, term distance measurement histograms of 0.75mm full width with a long term drift range of 2.25mm full width was obtained. By taking readings through an enclosed air column, the short term histogram width is reduced to 0.25-0.35mm with long term measurement drift on the order of 0.35-0.50mm providing there is no triggering on the fifth pulse (instead of the fourth) of the reflection burst. There has been some instability on the triggering threshold and have not been able to prevent jumping between the fourth and fifth pulse by at least one sensor using a common amplifier gain adjustment. Some efforts at capacitive phase shifting in an effort to balance sensors will be attempted. There was also a problem in attempting RS232 serial port readout of readings from the system. The vendor admitted to some prom problems and a new updated prom has been installed by returning the unit to the vendor. Successful test serial port readout was achieved on Oct. 28 and software modifications are nearly complete. Significant measurement test runs on the system to establish resolutions will be taken soon.

Extended stability test runs on a second BW3-BW1 transverse position sensing optics configuration have been completed with a MTE108CL source diode. Another collection of alternate new source diodes is ready for testing to optimize the Infrared source in our optics configuration.

A KEYENCE LB11, LB-70 high resolution (10 micron) laser diode distance measuring system (60mm to 140mm) has been setup and put under stability and temperature fluctuation tests. Search for a stable ruler for the detector system continues.

5. ARGONNE NATIONAL LABORATORY (ANL)

Lead Scintillator Plate Calorimeter

Barrel Calorimeter Mechanical Design

The design effort for the month of October concentrated on a study of optical fibre routing and intermodule space allocation to fibres. The space is limited and we are cognizant of the necessity for free areas of the HAC1/EMC, HAC1/HAC2 and HAC2/outer radius boundaries. These areas will be required to make inter module connections that will support tension, compression, and shear loads. Work completed indicates that the necessary space is available while still maintaining minimum module to module gaps (3 mm at the EMC, and 5 mm at the HAC1/HAC2 gaps).

End Cap Calorimeter Mechanical Design

Work has continued in parallel with barrel design, with effort concentrated on fibre routing that would allow the end cap EM section to be demounted and refurbished if radiation damage to the scintillator occurs. The design allows for all EM fibres to be routed radially outward in a deliberately created slot at the EMC/HAC1 interface. Fibres are then bundled and routed through the vertical gap between the barrel and end cap.

FEM Analysis

3D models of both the end cap and barrel have been completed and data is being analyzed. The finer mesh, 3D models of a barrel wedge and an end cap wedge have also been completed and the data obtained from the larger models will be applied to the finer mesh models to look at more sophisticated detail. The end goal of these exercises is to optimize the structural components of the modules.

Lead Creep Tests

A lead creep test has been set up in the laboratory with the goal of obtaining long term creep data on pure lead. By using elevated temperatures these tests should duplicate 10 year life cycle data on cast lead plates in the calorimeter.

Fermilab Beam Testing

Fixturing was completed during the month of October for adding the second test module to the test beam array. In addition three additional towers were instrumented in the test module that is in the Fermilab test beam at MP9.

Westinghouse Subcontract

3-D Analysis

We have constructed and run three cases, the highlights of which are shown in Table 1. Case O is an obsolete design. Case 1 (also called revision 1), reported in last month's report, has 7 attachment points between modules per Fig. 1. Case 2, also referred to as revision 2, is identical to case 1, except that there are 8 module attachment points per Fig. 2. Adding the 2 attachment points at H and I decreases the deflection, but also creates higher stresses at these two points. Some Case 2 stress plots are shown in Figs. 3 and 4. We are currently producing more stress plots to better show exactly where the stresses exist.

We feel that Case 2 represents a reasonably valid model, with manageable stresses and attachment forces. Most of our recent effort has focussed on this model. Figure 5 shows how the support was modeled. A total of 6 points on the outside of the end cap were constrained. These are points E, F, and G (from Fig. 2) at ~ angles of 236.25 and 303.75 degrees. Each of these angles is 33.75 degrees, or three module widths, away from bottom center. The top is given a Ø, coordinate of 90 degrees. The bottom is 270.

Figures 6-14 show the attachment forces at points A-I for all 32 modules. In these plots, x = R (radius), y = Ø, and z=z. If we assume that modules are held together with bolts that are perpendicular with the Ø, plane, then a negative y force produces tension on these bolts, and x and z forces are shear forces. Table 2 shows a condensed version of Figs. 6-12. For each of the 9 attachment points, the worst case in ø, is listed. R and z forces are vertically added to give a single shear force. A conservative design approach was chosen, in which axisymmetry is assumed, and all 32 joints in Ø, are designed to withstand the worst case in Ø.

HAC2 Design

A quarter scale hand layout has been made. There are 49 carbon steel plates in each HAC2 module. Tables 3, 4, and 5 show the coordinates, thicknesses, and slot locations for the 49 plates. The attachments between HAC2 plates within a module, and between HAC2 modules, have been designed. These designs are presently in the form of rough sketches, which a draftsman will start on this week. Money allowing we will produce detailed manufacturing drawings of plates nos. 3, 14, 18, and 25. These four plates should provide good cost data for the present Model B HAC2 design. If the hadronic calorimeter is all steel, then plate 25 becomes a typical averaged plate, so that the cost of this plate can be used to estimate that design as well.

Table 5-1

3-D Endcap Analysis Case Summary

Case Number	**0**	**1**	**2**
Description		Rev. 1	Rev. 2
Solid Outer Steel	YES	NO	NO
Lambda at Eta =3	12	11	11
Modules per Endcap	32	32	32
Mass of One Endcap (KG)	886938	465467	465467
Z Coord. of Endcap Cent. (M)	5.62	5.2015	5.2015
Z. Coord. of Endcap Front (M)		4.18594	4.18594
Z Coord. of Endcap Rear (M)		6.23438	4.23438
Attach. Pts. Between Modules		7	9

Table 5-2

Connection Forces Between Modules

Case 2. October 14, 1991

Connection Point	Tensile Force Normal to PHI Plane (KNT)	Radial Shear Force in PHI Plane (KNT)	Axial Shear Force in PHI Plane (KNT)	Total Shear Force in PHI Plane (KNT)
A	120	100	50	111.8
B	70	180	70	193.1
C	80	160	90	183.6
D	35	110	40	117.0
E	130	240	100	260.0
F	100	650	100	657.0
G	80	400	70	406.1
H	80	190	40	194.2
I	280	100	20	102.0

END CAP CALORIMETER MECHANICAL ANALYSIS
32 MODULES PER END CAP, 11.25° PER MODULE
REV 1: MODULES FASTENED AT POINTS A-G

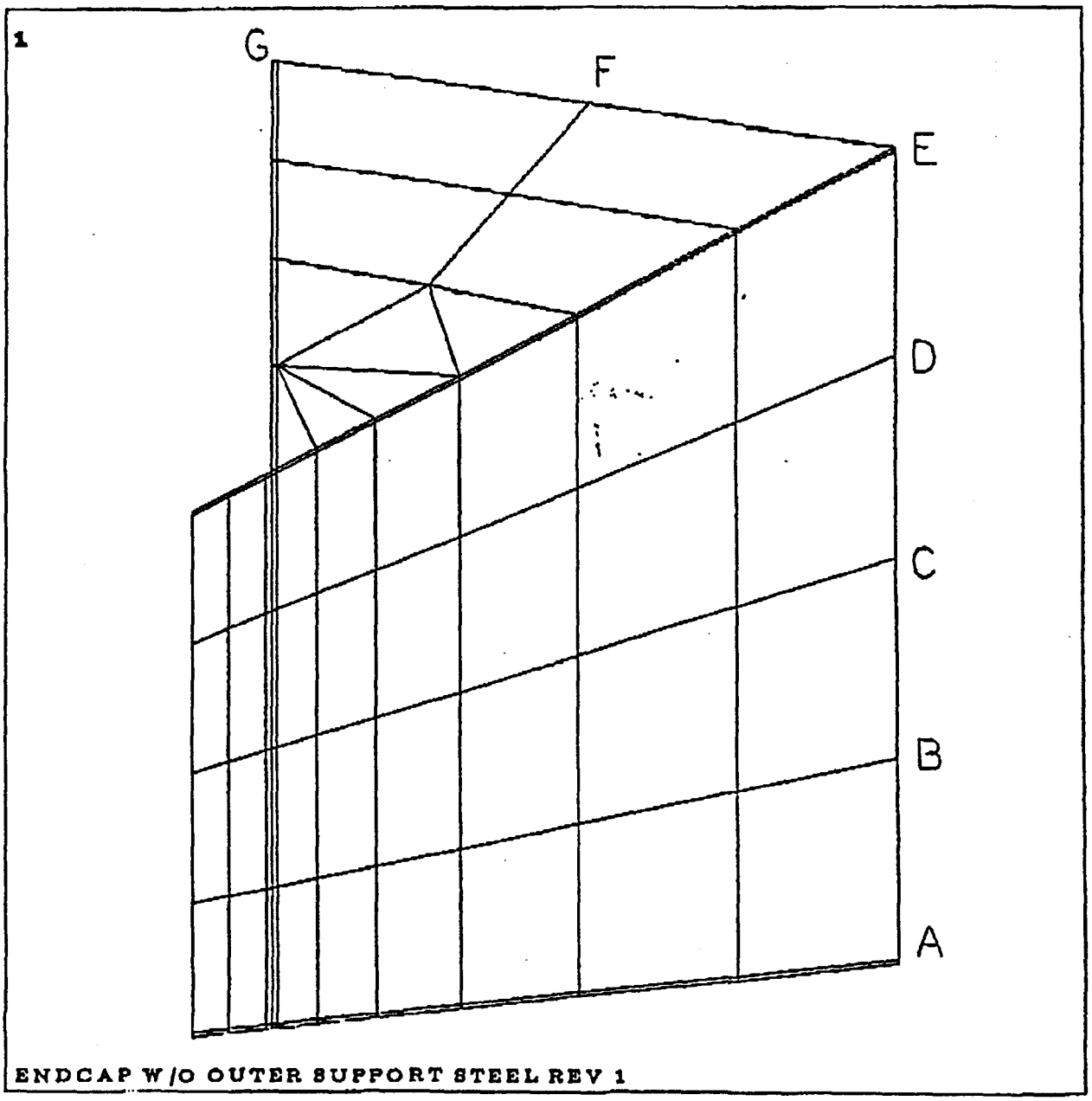


Figure 5-1

END CAP CALORIMETER MECHANICAL ANALYSIS
32 MODULES PER END CAP, 11.25° PER MODULE
REV 2: MODULES FASTENED AT POINTS A-I

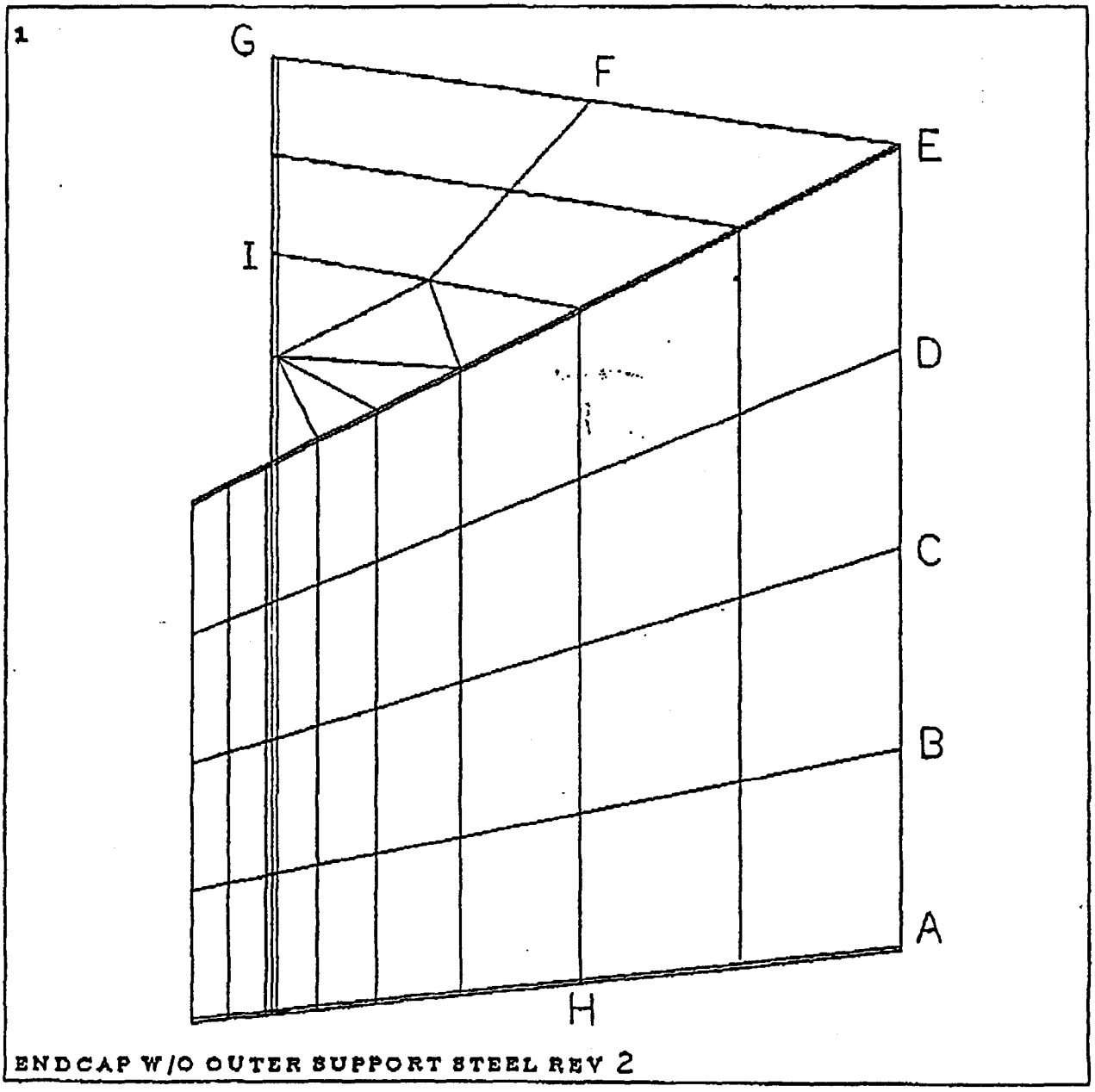
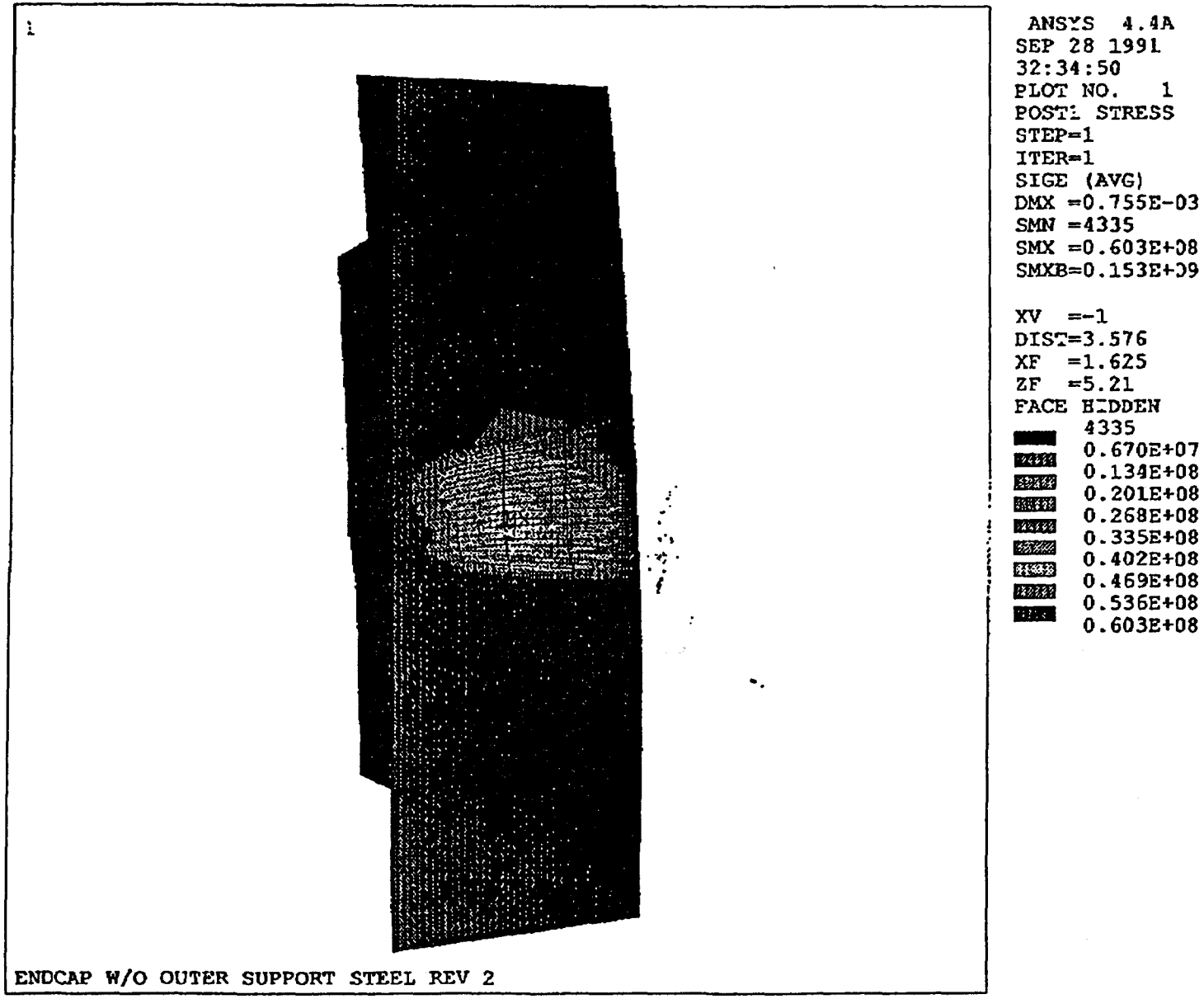


Figure 5-2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SMN =4335
SMX =0.603E+08
SMXB=0.153E+09
XV =-1
DIST=3.576
XF =1.625
ZF =5.21
FACE HIDDEN
4335
0.670E+07
0.134E+08
0.201E+08
0.268E+08
0.335E+08
0.402E+08
0.469E+08
0.536E+08
0.603E+08
ENDCAP W/O OUTER SUPPORT STEEL REV 2

Figure 5-3

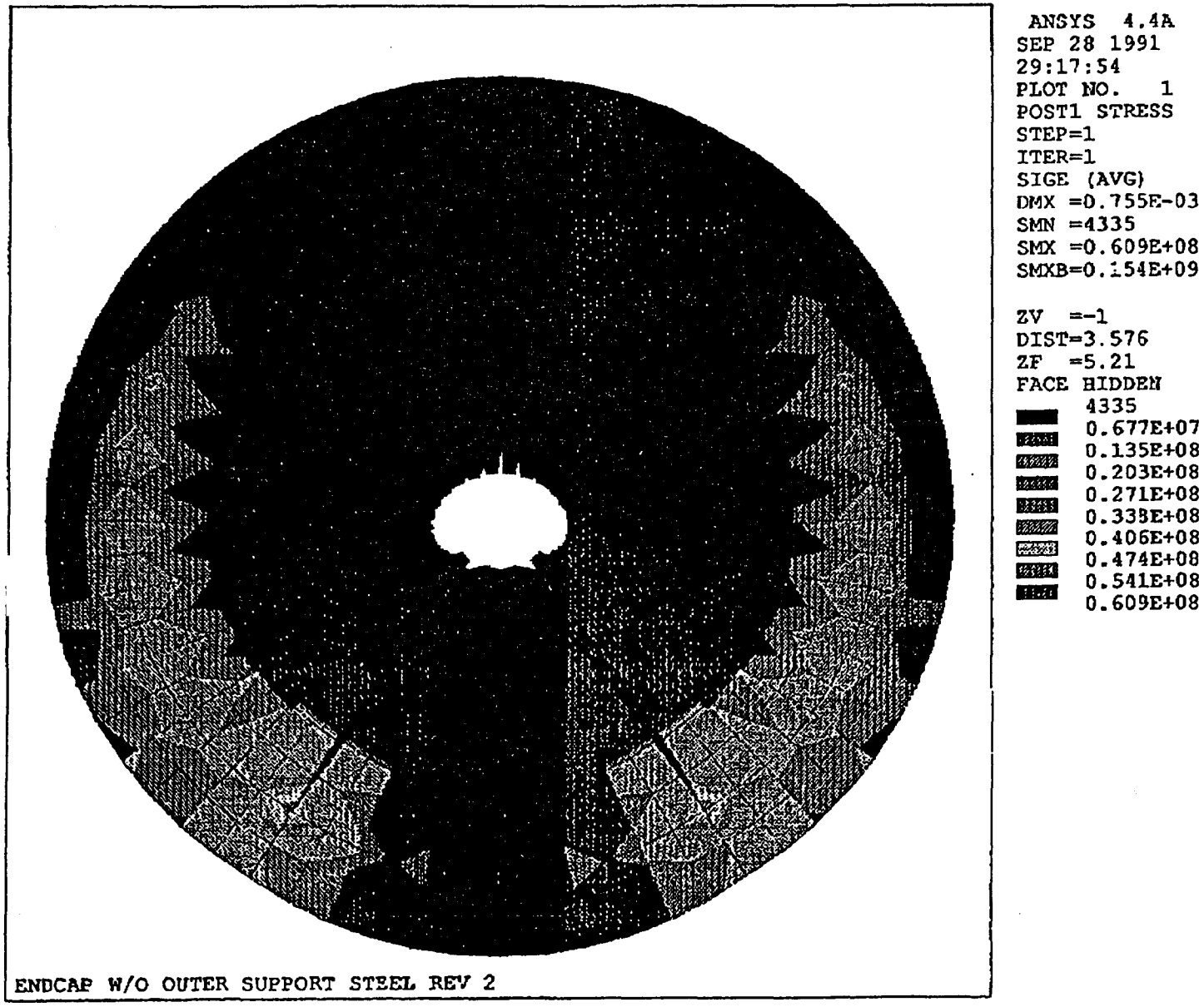
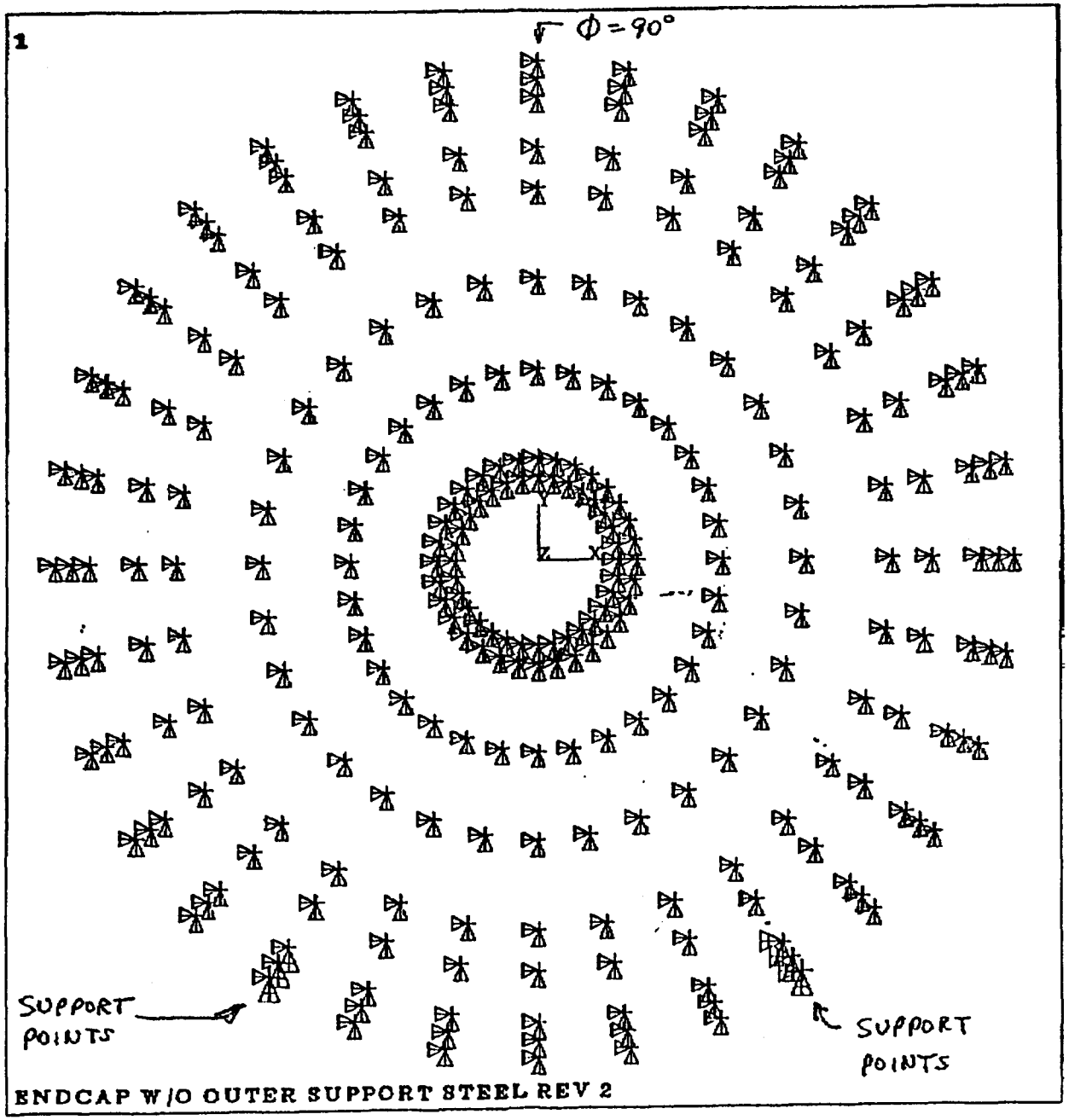

ANSYS 4.4A
SEP 28 1991
29:17:54
PLOT NO. 1
POST1 STRESS
STEP=1
ITER=1
SIGE (AVG)
DMX =0.755E-03
SMN =4335
SMX =0.609E+08
SMXB=0.154E+09
ZV =-1
DIST=3.576
ZF =5.21
FACE HIDDEN
4335
0.677E+07
0.135E+08
0.203E+08
0.271E+08
0.338E+08
0.406E+08
0.474E+08
0.541E+08
0.609E+08
ENDCAP W/O OUTER SUPPORT STEEL REV 2

Figure 5-4



ANSYS 4.4A
SEP 27 1991
11:46:13
PLOT NO. 1
PREP7 NODES
TDIS
CP

ZV =1
DIST=3.576
ZF =6.21

Figure 5-5

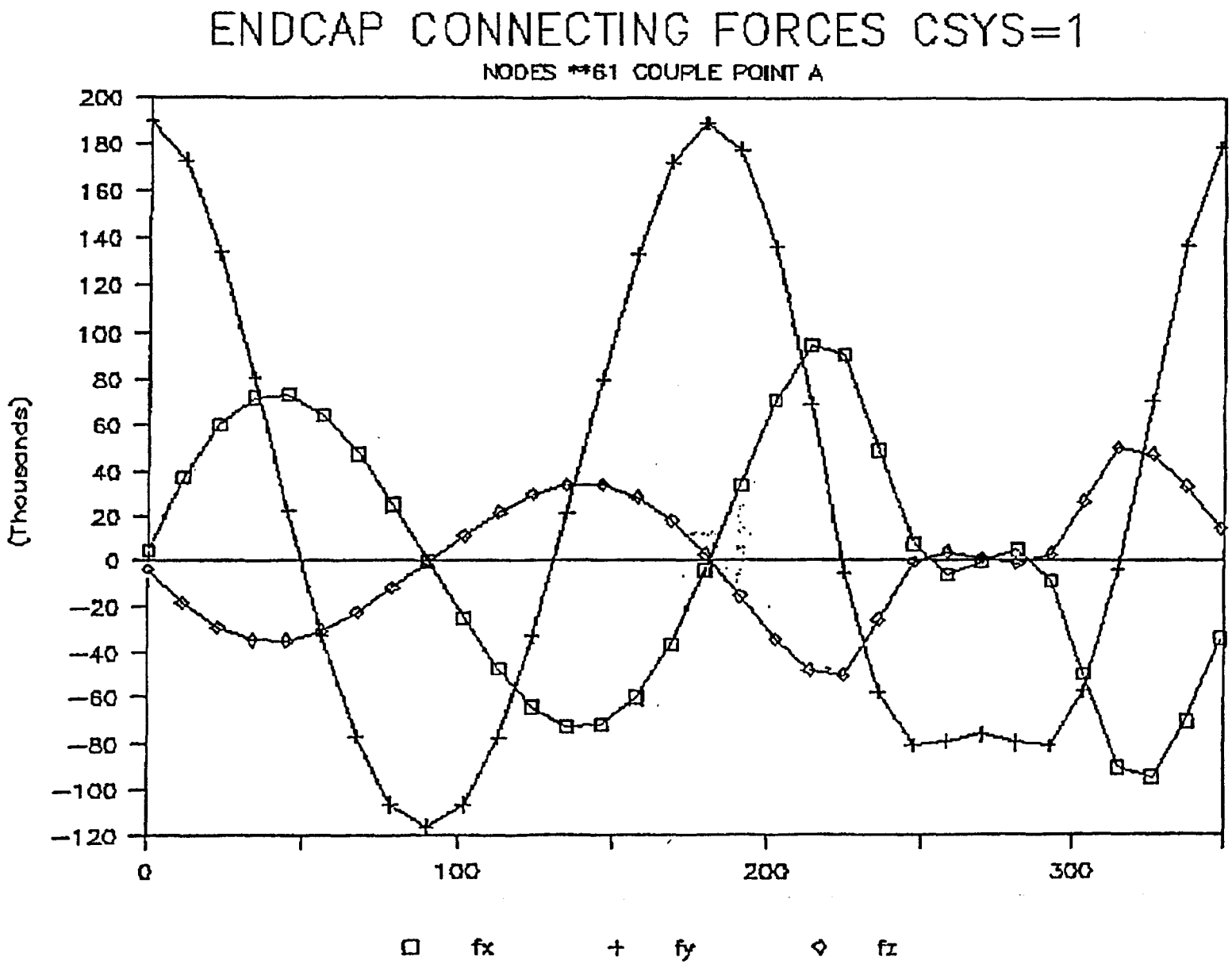

ENDCAP CONNECTING FORCES CSYS=1
NODES **61 COUPLE POINT A
(Thousands)
200
180
160
140
120
100
80
60
40
20
0
-20
-40
-60
-80
-100
-120
0
100
200
300
fx
fy
fz

Figure 5-6

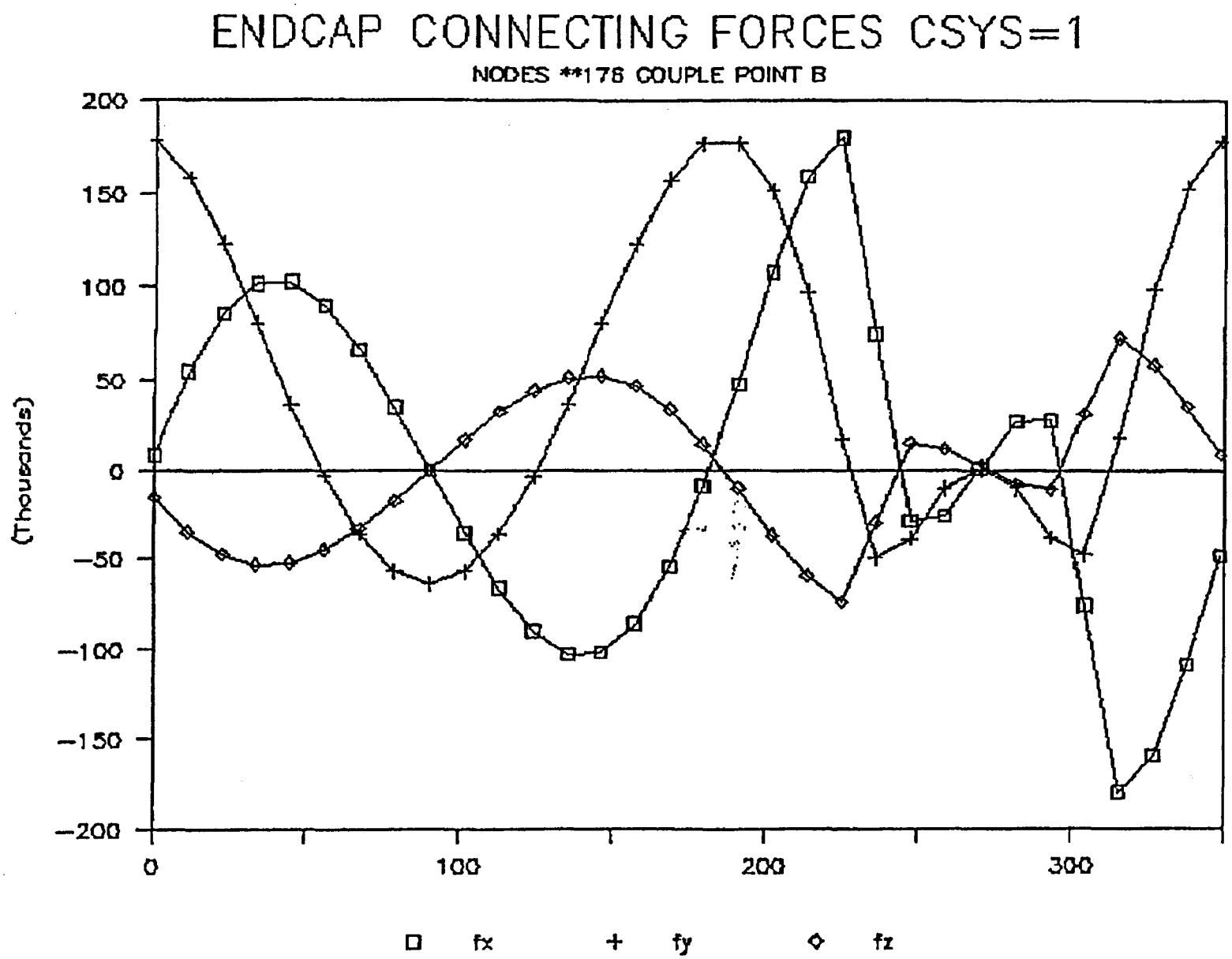

ENDCAP CONNECTING FORCES CSYS=1
NODES **176 COUPLE POINT B
(Thousands)
200
150
100
50
0
-50
-100
-150
-200
0
100
200
300
fx
fy
fz

Figure 5-7

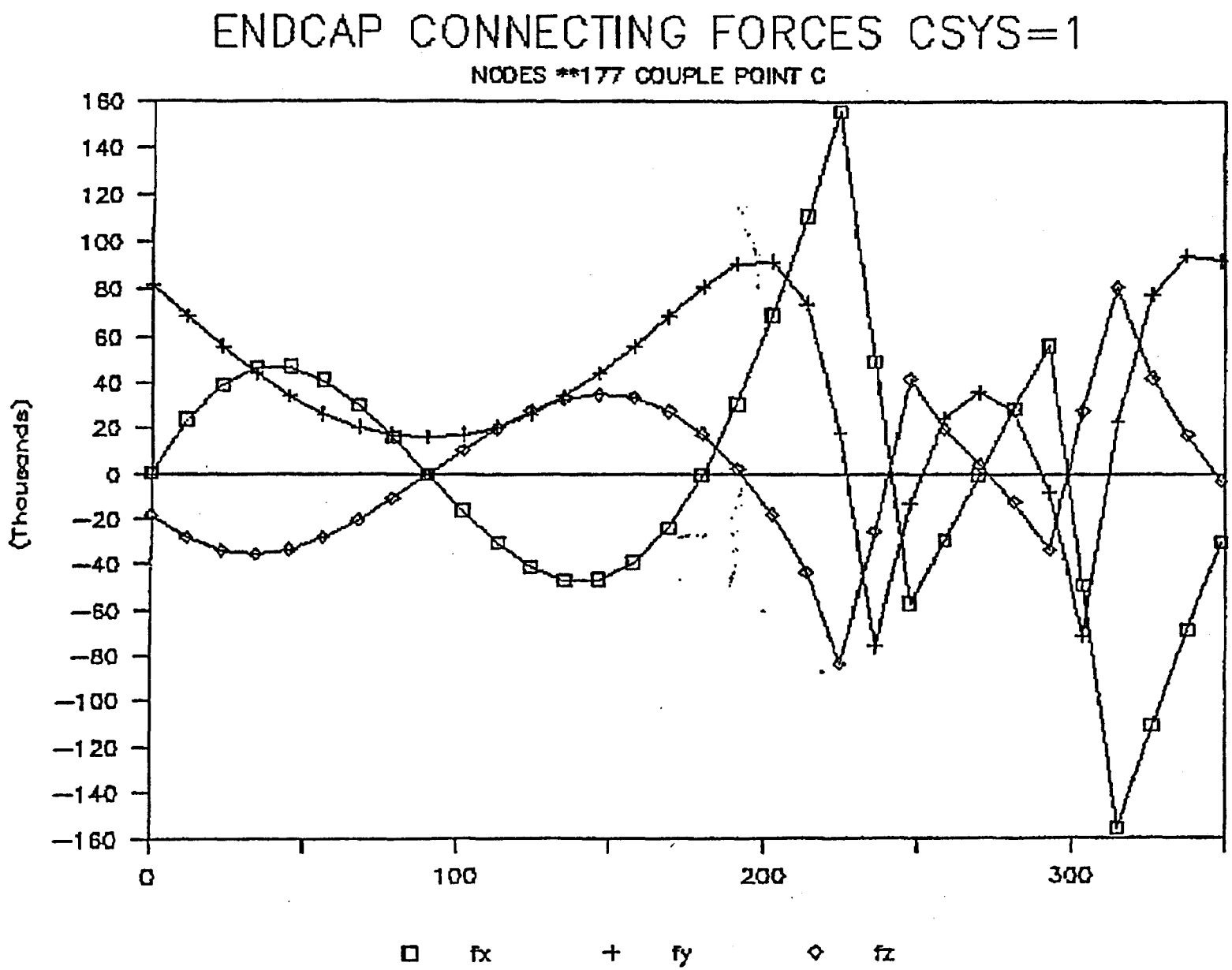

ENDCAP CONNECTING FORCES CSYS=1
NODES **177 COUPLE POINT C
(Thousands)
160
140
120
100
80
60
40
20
0
-20
-40
-60
-80
-100
-120
-140
-160
0
100
200
300
fx
fy
fz

Figure 5-8

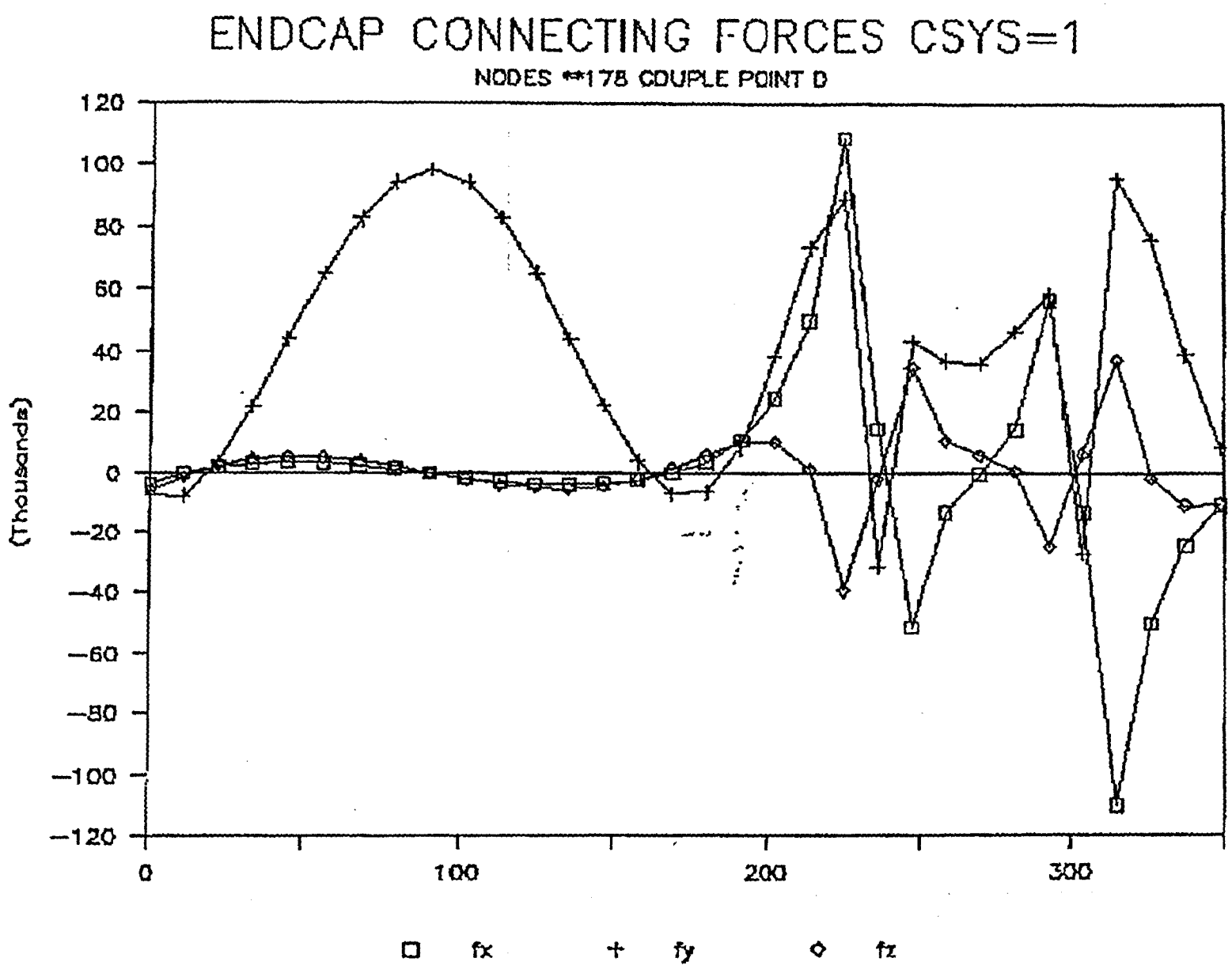

ENDCAP CONNECTING FORCES CSYS=1
NODES #178 COUPLE POINT D
(Thousands)
120
100
80
60
40
20
0
-20
-40
-60
-80
-100
-120
0
100
200
300
fx
fy
fz

Figure 5-9

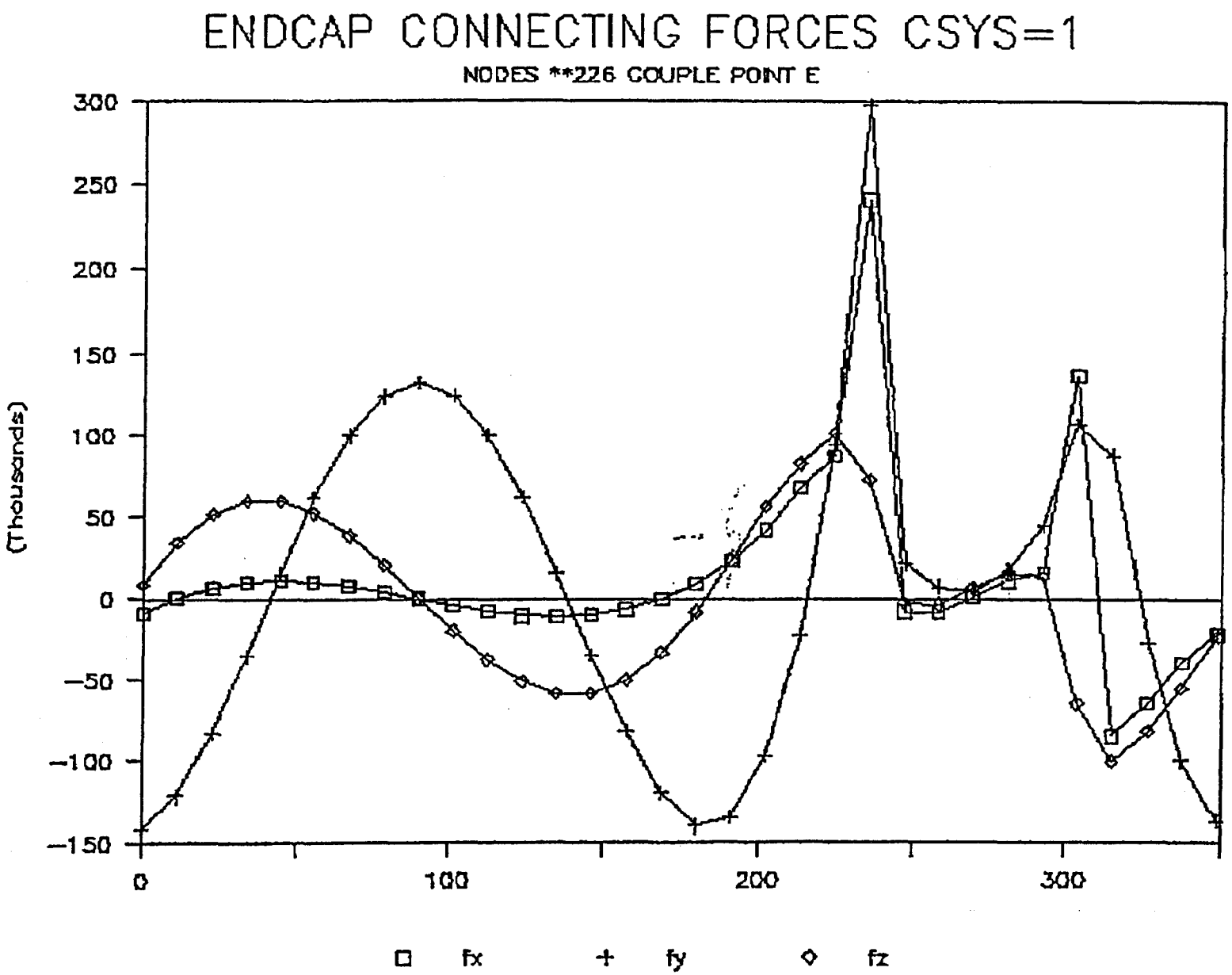

ENDCAP CONNECTING FORCES CSYS=1
NODES **226 COUPLE POINT E
(Thousands)
300
250
200
150
100
50
0
-50
-100
-150
0
100
200
300
fx
fy
fz

Figure 5-10

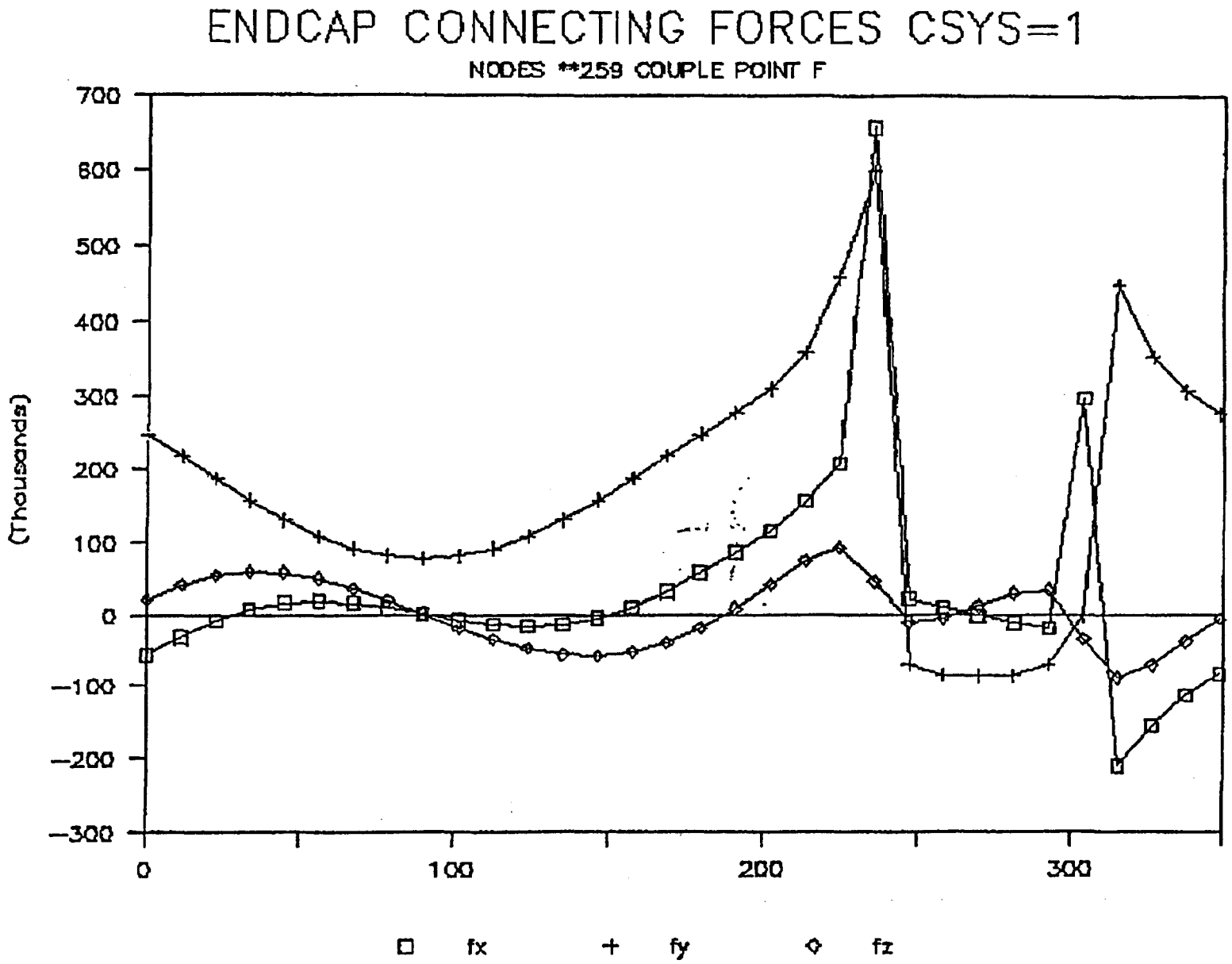

ENDCAP CONNECTING FORCES CSYS=1
NODES **259 COUPLE POINT F
(Thousands)
700
600
500
400
300
200
100
0
-100
-200
-300
0
100
200
300
fx
fy
fz

Figure 5-11

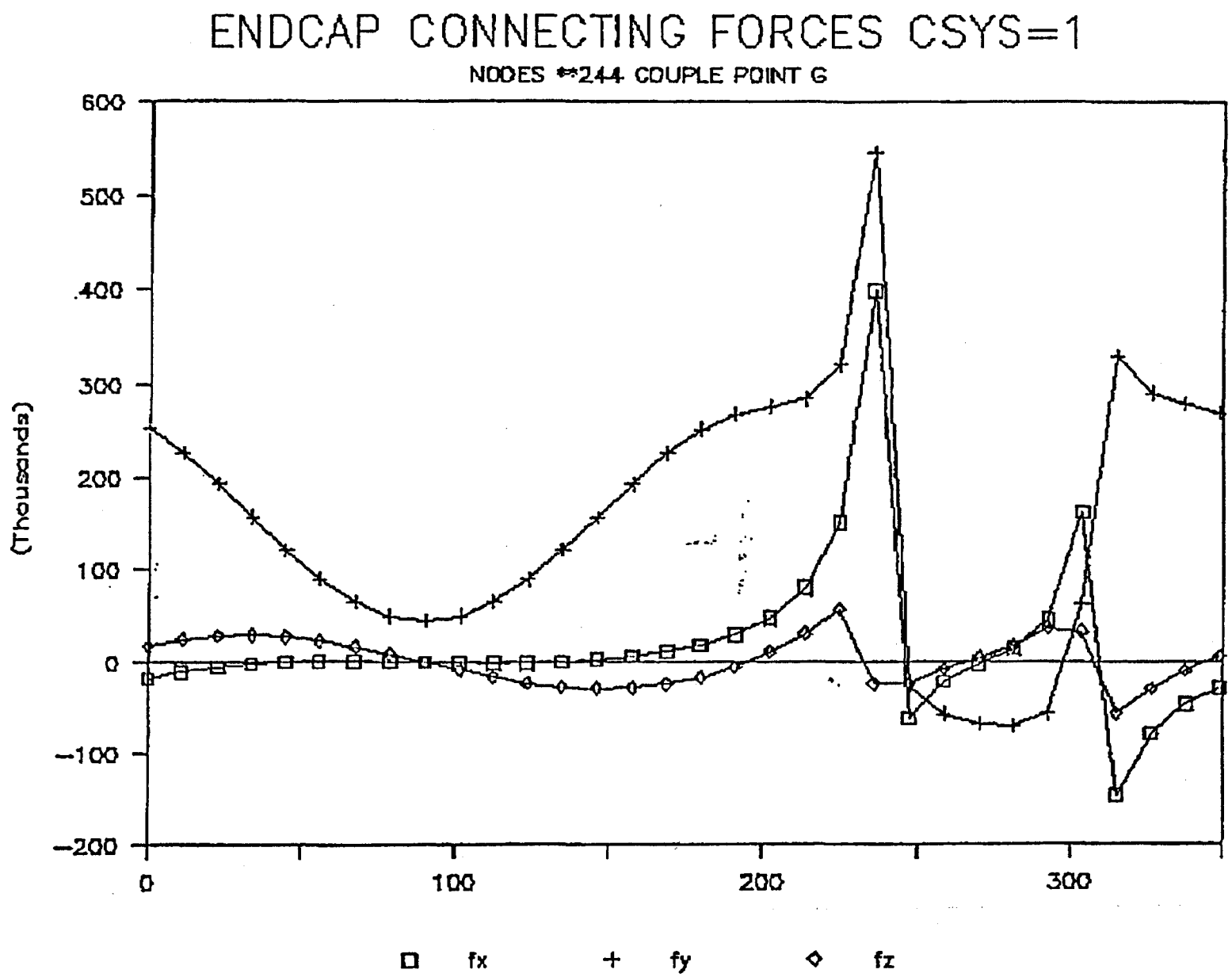

ENDCAP CONNECTING FORCES CSYS=1
NODES #244 COUPLE POINT G
(Thousands)
600
500
400
300
200
100
0
-100
-200
0
100
200
300
fx
fy
fz

Figure 5-12

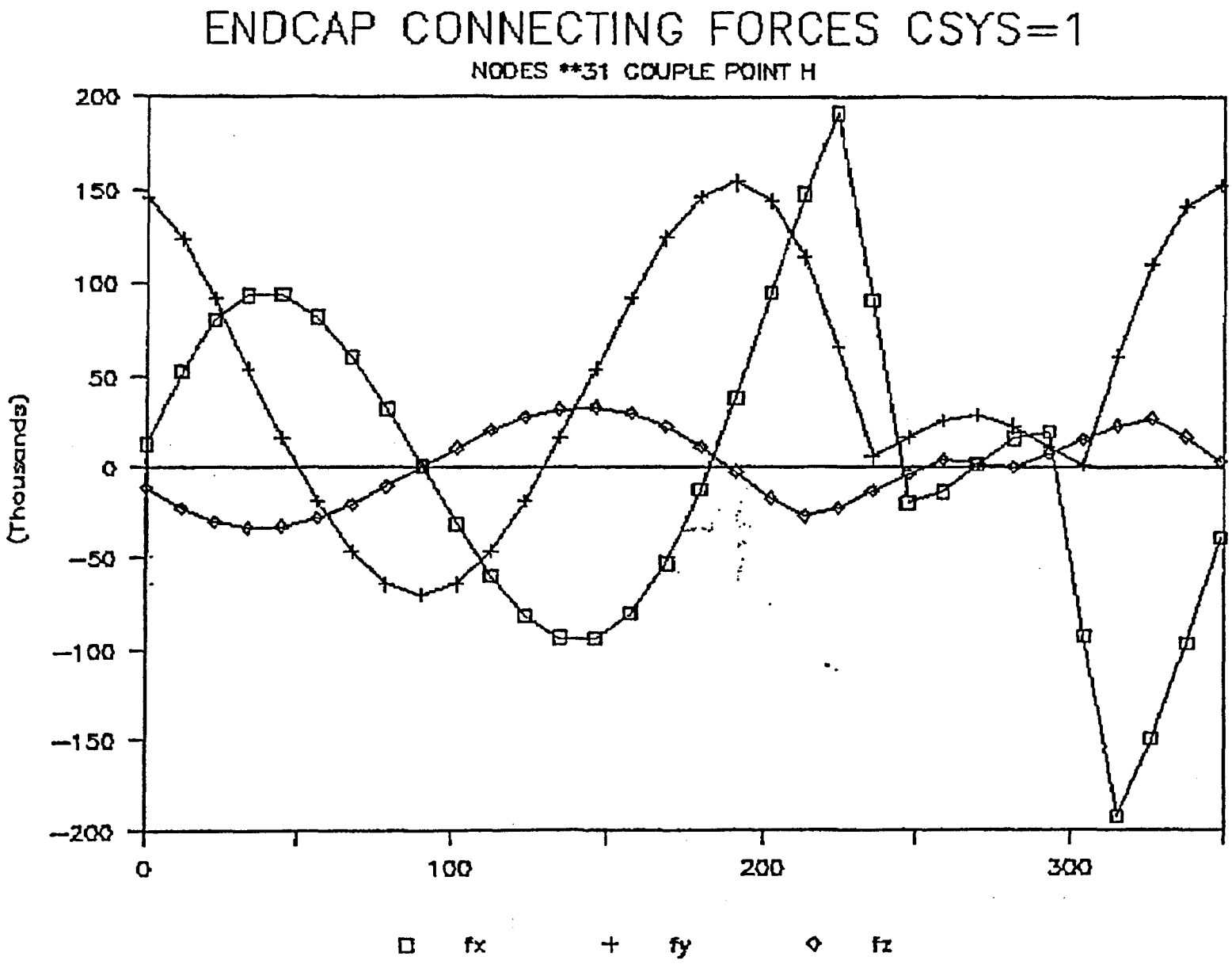

ENDCAP CONNECTING FORCES CSYS=1
NODES **31 COUPLE POINT H
(Thousands)
200
150
100
50
0
-50
-100
-150
-200
0
100
200
300
fx
fy
fz

Figure 5-13

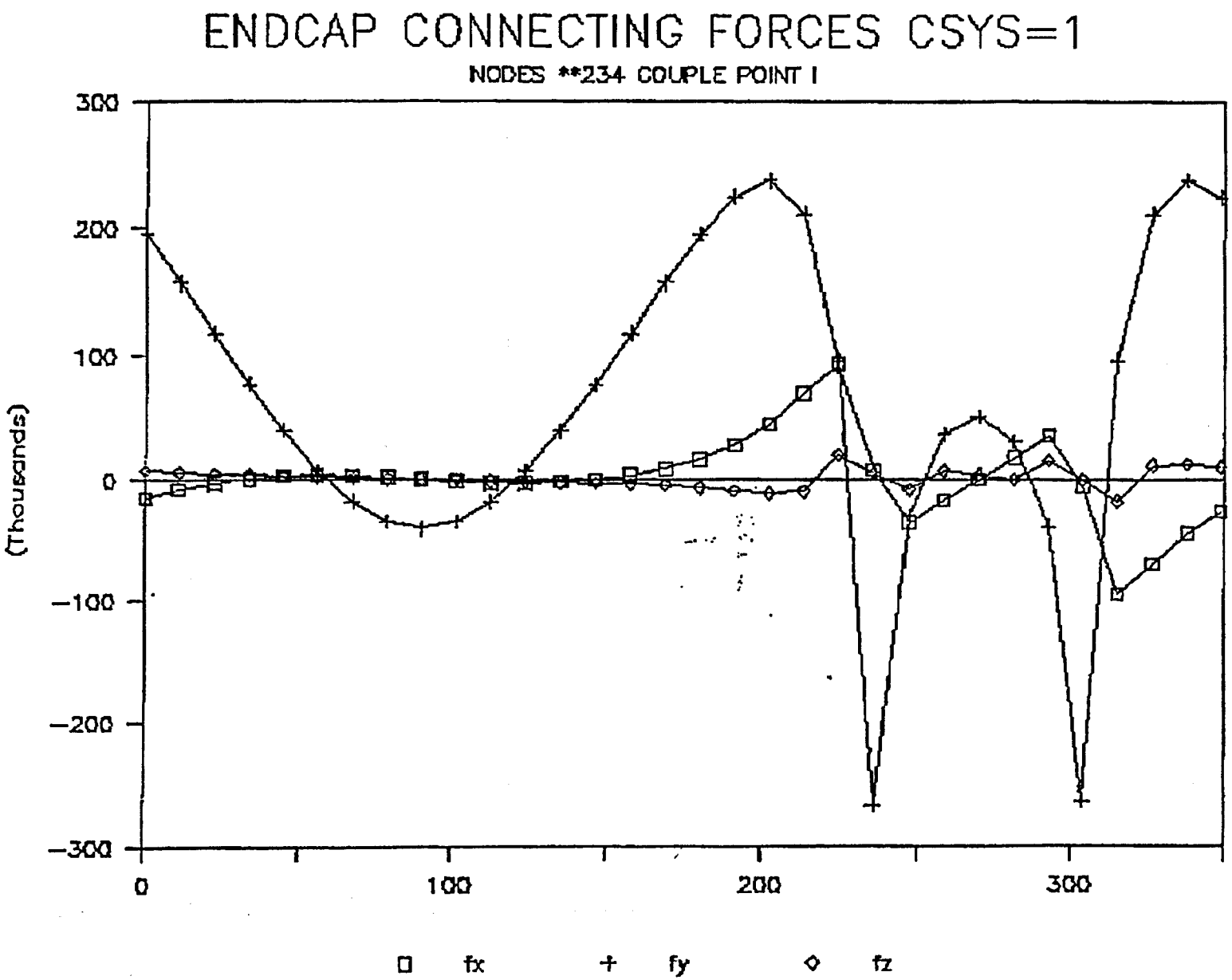

ENDCAP CONNECTING FORCES CSYS=1
NODES **234 COUPLE POINT I
300
200
100
0
-100
-200
-300
(Thousands)
0
100
200
300
fx
fy
fz

Figure 5-14

6. WESTINGHOUSE SCIENCE AND TECHNOLOGY CENTER (WSTC)

Efforts for the current contract have been completed.

7. UNIVERSITY OF MICHIGAN

Summary

We have continued the work on triggering with superlayers of straw tubes. The work during October has concentrated on the preparation of the conceptual design reports for both straw and muon triggering[9],[10]With respect to hardware design work, we have shifted from testing of the first generation of Application Specific Integrated Circuits (ASICs) to the preparation of modules into which these chips are to be installed. We will use the version one digital mean timers in detector tests and in radiation hardness tests. Simulation of tracking triggers continues with a focus on the quality of multilayer straw triggers for both level 1 and level 2 triggering.

Chip Development

The first design of the digital mean timer has proven adequately successful that it will be incorporated in a small number of NIM based modules. We will use these circuits for evaluation of the trigger timing options for the scintillators of the muon system. The scintillator/phototube options are being evaluated. Readout of the consecutive layers of the muon scintillators from opposing ends appears to be promising as a way to eliminate the uncertainty in the crossing number that arises from the timing differences for tracks near and far from the phototube. The NIM modules made with digital mean timers will process these opposing readouts into a time stable signal.

Another cycle of chips is being designed for submission in December or early January. One of these designs is configured for the UTMC radiation hard process. For comparison, we are planning to irradiate some of the current radiation soft design. The second, MOSIS design was described in the September report. We will continue to study the first version of the chip as it is used to evaluate triggering options.

We have continued to work on trigger simulation in the framework of GEANT and a fast emulation of a stiff track trigger. We continue to pursue a trigger based on 8 straw tubes per superlayer. A trigger based on 3 superlayers of 8 straws and mean timers is clearly viable for triggering on straw tubes. Future work will concentrate on the electron triggering efficiency and on the multilayer efficiency for various level 1 an 2 trigger algorithms.

Cosmic-ray Test Stand

The cosmic-ray test stand is mechanically complete with scintillator trigger counters, straw tube layer, amplifier-discriminators, and cabling. We await the

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[9]SDC Straw Trigger Pereliminary Conceptual Design, J. Chapman, A. Dunn, and J. Mann, UMHE-91-39, (1991)

[10]SDC Muon Trigger Preliminary Conceptual Design, J. Chapman and R/ Thun, UMHE-91-34 (1991)

new boards (fabricated in Colorado) that use the PENN electronics. The LeCroy 1879 Fastbus TDC is in place and available for use within November.

Muon Trigger

The muon trigger preliminary conceptual design report has been extended to include the forward muon system and continues to be developed in detail. The channel counts and regional node card count is specified and individual card designs are being specified. The original assumptions about channel densities remain viable as the design becomes more specific. This process will continue and the numbers that evolve from it will be incorporated into the WBS accounting. The Dallas meeting on the forward system October 26th was very helpful in pinning down the channel counts. Comparison of the regional node component specification with that prepared by the DAQ and front-end groups is next on the agenda to eliminate double counting.

8. LOS ALAMOS NATIONAL LABORATORY (LANL)

Los Alamos National Laboratory efforts were directed towards completion of a Conceptual Design Review (CDR) document, participation in an SDC subsystem research and development status meeting, and preparation of cost and schedule estimates for FY92.

The CDR document addresses mechanical engineering and design, evaporative cooling, radiation length, and alignment and assembly issues of the silicon tracking systems (STS). The subsystem meeting featured presentations on the above and fruitful discussions with University of California at Santa Cruz and Lawrence Berkeley Laboratory personnel. The cost and schedule estimates are evolutionary and currently reflect a descoped STS using approximately 17 m^2 of silicon instead of the original 27.7 m^2. This activity is expected to continue through November.

9. ICF – KAISER ENGINEERS (KE)

Preliminary construction planning activities were concluded this month and the results are included in a final report submitted to the SDC. This concludes the Contract tasks except for clarifications or minor changes that may be requested.

The report consists of 150 pages which includes 95 illustrations on how to assemble the detector. Estimates of labor and crane usage required for the installation of the large mechanical components are included. 35 mm color slides were made of computer screen shaded views of most of the situations presented in the illustrations.

All computer files were put on tape and provided to the SSCL in Dallas, together with lists of levels which will facilitate the reproduction of the drawings presented in the report.

10. LAWRENCE BERKELEY LABORATORY (LBL)

Integration and Management

Electrical Systems Integration Group (ESIG)

Information was prepared for the Engineering Integration Meeting at SSCL. Items discussed at the meeting included various electronics options for placement within the detector. A new approach of mounting interior electronics crates in racks within the detector was presented.

At the Cost/Schedule kickoff meeting, the intent of which was to establish the ground rules for development of future costing information, the ESIG assembled the information and is distributing it to the electronics systems costing coordinators.

A new cable plant requirements matrix was developed that supports the latest configuration of systems mounted in interior racks. ESIG also developed information on cabling for a "no detector electronics" option where an absolute minimum electronics compliment is mounted within the detector.

ESIG began reviewing subsystem costing information for presentation to the Collaboration during the November meeting. We also updated the Electronics Integration Diagram to reflect the latest changes in subsystem configurations.

Cost and Schedule

The final "Baseline" cost rollup was completed. The cost rollup and conversion software is ready to use. All information now exists at SSCL. The C/S effort has largely been shifted to SSCL, where we had a kickoff meeting for the "Descoped" detector on October 23-24. Attendees were given guidelines for the specific C/S systems they use. They received many of the files needed in magnetic media. Subsystem specific problems with preceding C/S efforts and recommendations for improvement were reviewed with the C/S subsystem coordinators.

Silicon Tracking

Thermal & Structural Analysis

In a continuing effort to reduce the detector temperature, the oreo read out stack was moved outboard of the cooling ring. This configuration results in a small region (about 20 mm) of increased temperature while most of the detector is at a very low value. Several other modifications were made that greatly improved the thermal and deflection performance of the module. As shown on Figure 1, the top and bottom stack is symmetric which eliminates bowing due to the bi-metallic effect caused by cooling from room temperature

to 0° C. Also, one end of the readout subassembly is not attached to the detector. This further reduces deflections.

Figures 1, 2 and 3 show the three designs evaluated. The increase in the detector leakage charge was determined for each configuration based upon the centerline temperature. These temperature profiles are shown on Figure 4. The design shown by Figure 3 attempted to further reduce the temperature and cost.

The configuration proposed as a baseline is that shown on Figure 2. Table 1 summarizes the results of the thermal/deflection analyses.

Table 10-1

Configuration	Max. Det. temp	% det	% noise
With kapton	5.6	14.4	3.0
Gas vice kapton	3.1	7.4	1.5
Modified be	2.1	6.4	1.3

The deflection of the modules is due to gravity and thermal gradients resulting from applying power to the electronics and cooling from room temperature to the operating temperature. For the cases considered, the total deflection was about 60 um with 50 um due to gravity. The deflection due to readout power on was 2 um, therefore, about 10 um was due to cooldown from room temperature to 0°

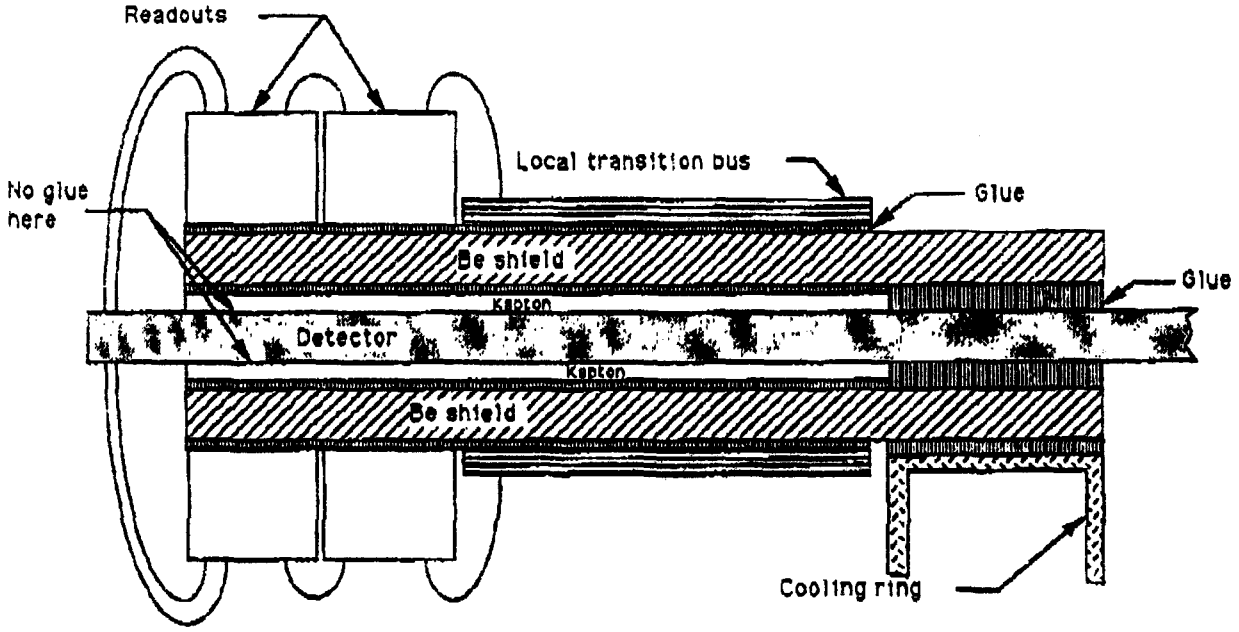

Figure 10-1 Baseline with kapton

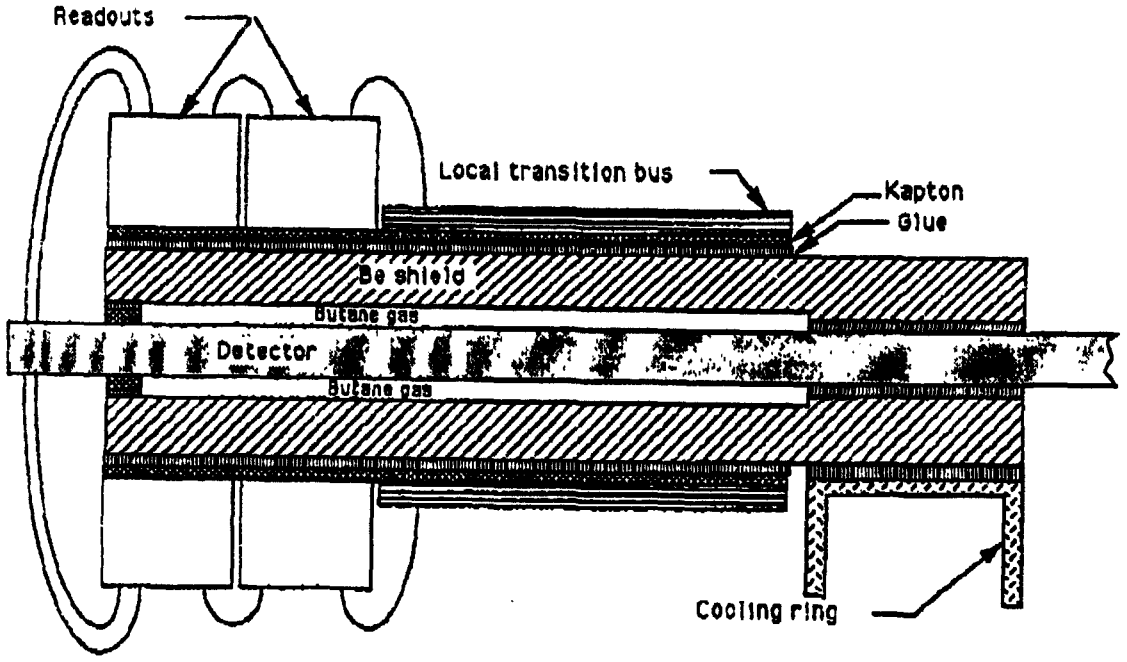

Figure 10-2 Modification with butane gas in place of kapton.

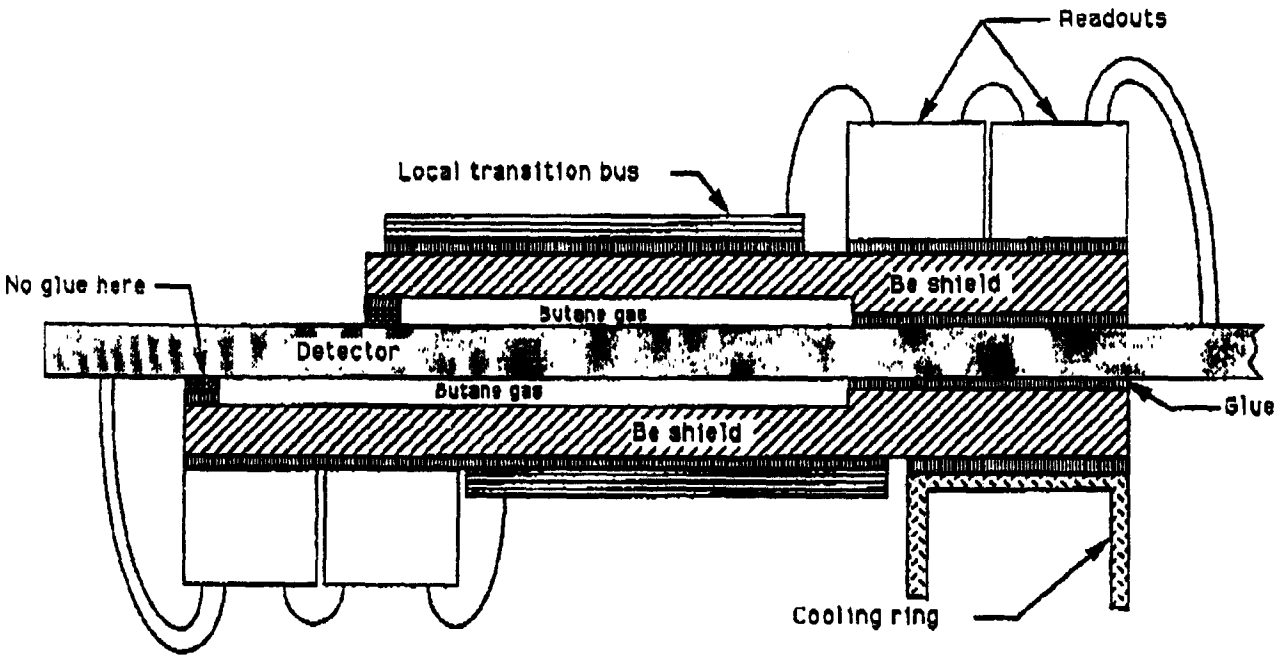

Figure 10-3 Modification with reduced beryllium.

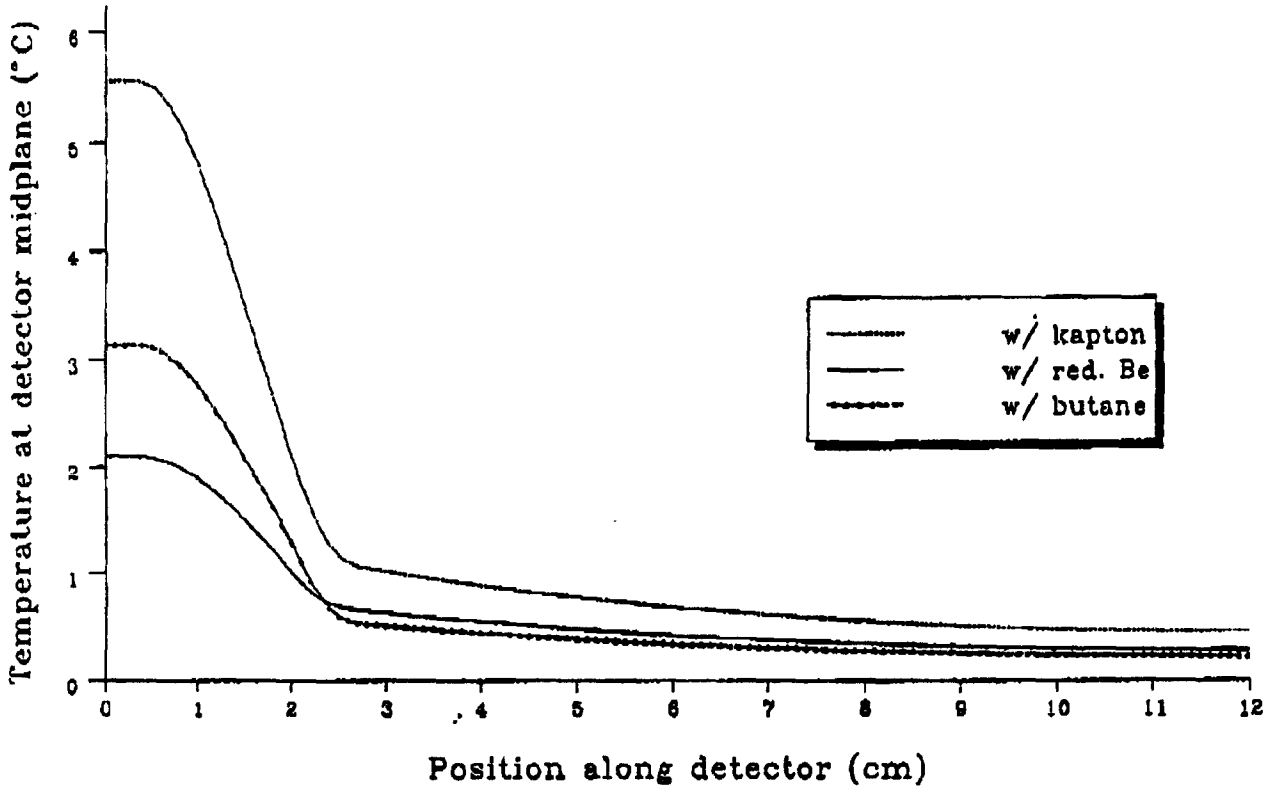

Figure 10-4

Computing Systems

The initial installation of the RS/6000 went well, but difficulties have arisen with its connection to the Internet. There apparently is an inconsistency in the interpretation of the format of legal Ethernet packets between IBM and Cisco, the makers of Internet routers. The router should move packets from the Ethernet segment directly connected to the RS/6000 to the segments which connect the rest of LBL and, in turn, the rest of the world. Unfortunately, the Cisco router claims that the IBM packets have framing errors and refuses to handle them. This means that there is very limited network access from the IBM; no name service, no printing, no effective Email. The situation is currently unresolved. IBM is sending the latest version of their driver and telling us to upgrade the Cisco routers. Since there are many more routers than IBMs the local network experts are looking for alternatives. While it will still be possible to use the RS/6000 for its queuing modeler role, it will be much more awkward to use. The problem will no doubt be solved eventually, but meanwhile it has consumed considerable time.

Other efforts this month were devoted to preparing a presentation to DOE for the HPCCI "Database Computing for the SSC" proposal of which this work is a part. Presentations and draft forms of sections on computing for the SDC Technical Proposal were prepared for the SDC Computing Workshop in Dallas, 21 Oct – 1 Nov. Presentations were made to members of the SSCL Compting Division, among others.

Work is continuing in order to consolidate the efforts from FY91, in particular, reorganizing the C++ code for building CDF Ybos banks into ObjectStore databases. This code will be considerably extended over the next year to handle all of the banks which can appear in CDF events.

B. PROGRAM COSTS

The budgets indicated below are for FY91 "post-LoI" funds allocated April 1991 and August - October 1991.

Institution	Budget K$	October Cost (Actual or Estimated)	Prior Months (actual cost) K$	Total Cost $
1. ORNL	210	—	—	—
2. PSL - Muon	80	6.7	8.5	15.2
3. PSL-Trigger	75	8.5	25.6	34.2
4. FNAL				
A. SC Solenoid	393	113.5	398.3	511.8
B. Calorimetry	159	4.0	87.3	91.3
C. Data Acq. Sys.	50	15.0	16.7	31.7
D. Muon	63	5.0	10.4	15.4
E. Fiber Tracker Read-out	65	0	0	0
F. Calorimeter Electronics	65	0	132.7	132.7
5. ANL	230	0	118.4	118.4
6. WSTC	123	0	123.0	123.0
7. U. MICHIGAN	83	0	0	0
8. LANL	150	NA	135.0	NA
9. KE	210	35.0	169.1	204.1
10. LBL				
A. Integration & Mgmt.	673	90	731.1	821.1
b. Liq. A Calorimetry	0	0	221.4	221.4
C. Silicon Tracker	72	23	49.9	72.9
D. Computing Systems	119	0	128.7	128.7
E. Calorimetry Electronics	25	0	44.5	44.5
F. Contract Costs	53	–0	53.0	53.0
11. IBM	35	—	—	—
12. U. CHICAGO	47	—	—	—
13. HARVARD	47	—	—	—
14. U. PENNSYLVANIA	62	—	—	—
15. SANDIA	38	—	—	—