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ABSTRACT

The Satellite Technology Demonstration employs the latest telecommunications technology to deliver community oriented programing to rural areas. To meet the demand for contemporary broadcasts responsive to community needs, a studio was constructed in the Denver area to produce and coordinate future programs for the Rocky Mountains area. Problems were encountered in the site selection, design, equipment procurement, installation, personnel selection, and inadequate lead time. This report reviews details of the project's beginnings and makes recommendations for the future. (EMH)

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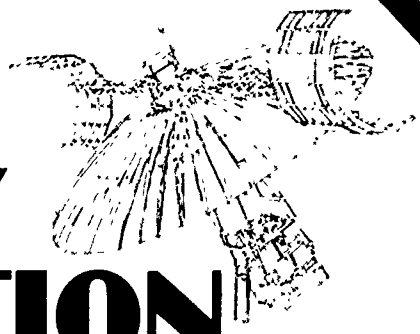

SATELLITE TECHNOLOGY DEMONSTRATION

FEDERATION OF ROCKY MOUNTAIN STATES, INC.

technical report

TR0504

AN HISTORICAL OVERVIEW OF THE PRODUCTION REQUIREMENT FOR THE SATELLITE TECHNOLOGY DEMONSTRATION

U S DEPARTMENT OF HEALTH, EDUCATION & WELFARE
NATIONAL INSTITUTE OF EDUCATION

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INTRODUCTION

The Satellite Technology Demonstration (STD) submitted a planning document to its federal sponsor (the National Institute of Education) on July 28, 1972 (Federation of Rocky Mountain States, Incorporated [FRMS] Report and Proposal). In it, the STD called for a "Production Component" to manage and operate a "minimal production facility." Programming would center on both "Early Childhood Education" and "Career Education."

The dimensions of this programming were set by the National Aeronautics and Space Administration's (NASA's) Applications Technology Satellite (ATS) Operations and Control Center. This center allocates available air time for more than 25 experiments who use ATS-6 power resources.

STD staff members immediately set out to find ways to obtain or produce an estimated "200 to 400 hours of program material which would be timely and relevant two years in the future..." (FRMS Report and Proposal, page IX-1). They assumed that any program material would be repeated for each of the two Rocky Mountain "footprints," or satellite antenna patterns, which were available to cover the STD sites.

The estimate came very close to the actual transmission time for both footprints--approximately 480 hours. The requirement for new program material, produced in the studio, was 75 hours; all 75 hours were aimed at Career Education. The remaining time was filled by repeating several programs during the second school semester and by using tapes and films from the STD's Materials Distribution Center.

PRODUCTION REQUIREMENTS

Initially, the STD investigated the possibility of not using an in-house production studio; instead, it considered editing and transmitting material obtained from outside sources. The thinking, here, was that it would be desirable to have most, if not all, program material in hand before transmission began in the fall, 1974.

An extensive search of available, career-education material, however, confirmed a fundamental truth about any film or video programming: It is dated, in concept and execution, by the passage of time. The available material did not meet the objectives specified by

STD content personnel. Most of the material was eliminated, because it was outdated; some, because it had poor pictorial quality.

Existing Regional Production Resources

The STD then considered the medium of production: motion picture film and/or video tape. Commercial, nontheatrical film producers and public television stations in the eight-state region were surveyed to determine if they could produce the necessary films and/or tapes. Although competent commercial and educational film producers were available, no one could produce the program materials in sufficient quantity to meet Project requirements. Further, a heavy reliance on film was impractical from an economic standpoint, as noted in the Report and Proposal, page IX-3:

> The average per minute cost of nontheatrical motion picture production in the region is approximately $1,300...(an amount which)...exceeds the $1,200,000 budgeted for programming.

The staff concluded that some assistance could be purchased from the region's resources, but that the program requirement for the Demonstration equaled or exceeded the annual new production in the region. Thus, a new production design would be necessary to supply the material and to stay within the constraints of a limited budget.

The Interactive Satellite System

The ATS-6 communications system further pointed to the need for an in-house production capability. The system was unique in that it was designed to provide two-way telecommunications; this capability made real-time interaction between the Denver studio and the remote sites mandatory. It was also electronic; this feature meant that a ground system and production facility would be necessary to monitor programming.

These factors, particularly interaction, prompted the Report and Proposal to conclude that two-way communications would not only be desirable, but also invaluable in the concept and operation of the STD. It would provide point-of-origin communication between the STD in Denver and 24 Intensive Terminal (IT) sites, as well as voice-to-voice communication among all participating sites in the region.

The need for two-way communications was reinforced by user needs. Report and Proposal, page V-14, noted this:

> The Project can be successful only to the extent that it meets genuine user needs. To identify these needs accurately and to make program modifications, based on user reaction, will require extensive user input and involvement. The point to be made, here, is that...the users are <u>in fact</u> providing input for program decisions.

The STD Recommendation

The STD and its federal sponsor ultimately agreed to design and construct a production facility similar to a television station--a responsive electronic communications system that could accept material produced in any visual medium. The Report and Proposal, page IX-2, said this:

> The Federation proposes to solve the program requirement by creating a production capability which will utilize the region's resources to the maximum extent...and, at the same time, increase the production to the necessary level for the Demonstration.

PRODUCTION IMPLICATIONS

As originally designed and constructed by Fairchild Industries, Incorporated, Applications Technology Satellite F (or ATS-6) contained transponders that were capable of sending and receiving one color video channel and four voice/data channels from small ground terminals. The implications for production included emphasis on two-way communications, as previously noted, as well as on two-way video origination between Denver and the remote sites in the region. Production plans centered on: (1) program origination from 12 public television stations in the eight mountain states; (2) video origination from any location in the region via a mobile terminal; and (3) two-way voice/data communications between all participating sites.

In February, 1973, after the ground system design was complete, the Interagency Radio Advisory Committee (IRAC) denied NASA's request to clear 2.25 GHz frequencies for the Demonstration. This denial was based on the recommendations of several agencies. The Department of Defense, for example, said that video transmission on this band (in the continental United States) would interfere with military communications experiments. The IRAC finally cleared the 2.25 GHz frequency for use only in Alaska. At the same time, the STD's federal sponsor determined that the costs for originating video programs at STD sites were prohibitive. These two events forced the STD to redesign its communications system.

A study was conducted to compare the costs of: (1) redesigning the ATS-6; and (2) using land-lines to a limited number of sites in the region for two-way voice communications. The study revealed that it would be too costly to make the necessary frequency change to the ATS-6; it also would be too costly to install land-lines at sites. While the study was underway, the STD's engineering staff determined that the ATS-3, an earlier satellite, could be used at minimum cost. Use of the ATS-3, however, was favorable only in rural and rural-isolated communities, because its frequency interfered with certain commercial band widths in urban areas. The STD finally decided to use the ATS-3 as the audio communications link between rural and rural-isolated Intensive Terminal (IT) sites and Denver and to use land-lines between urban and metropolitan IT's and Denver.

The ATS-3's transmit and receive frequencies (149 MHz and 135 MHz) required a separate communications system, and additional equipment and program requirements were necessary to coordinate programming with video transmission over the ATS-6. (The uplink near Denver was cleared to transmit video and audio at 6 GHz and to monitor the satellite at 4 GHz.)

This dual system, like most compromises, was not ideal; technical and programming difficulties soon became apparent. Programming, for example, had to be redesigned to include interactive segments that eliminated more than half the sites from participating in the Project. The audiences at the nonparticipating sites could observe the video and hear the dialogue, but they could not interact in real time. In order to maintain interest at the Receive-Only Terminal (ROT) sites, program segments were devoted periodically to answering written questions from the audience. The dual system, however, did provide an experimental base and a control for assessing the value of direct interaction.

PRODUCTION PERSONNEL

The Report and Proposal, page IX-9, identified three positions on the Production staff: Director, Executive Producer, and Operations (or Facilities) Manager. The search for a Director began in August, 1972. The position was filled in November of that year, but it was not until April, 1973 (shortly after production began) that the staff was finalized at 21. Not including content specialists and secretarial personnel, the Production Component included the following:

- --One Director
- --One Executive Producer
- --One Operations Manager
- --Two Directors
- --Three Writers
- --One Design Artist
- --One Staff Artist
- --One Chief Engineer
- --Two Camerapersons
- --One Audioperson
- --One Lighting Director
- --One Floorperson
- --One Technical Director
- --Three Video Technicians
- --One Production Assistant

Production personnel faced an almost impossible deadline. Production began March 1, 1974, but it did not reach full scale until August 1, 1974. Yet, the first program transmission (over the ATS-6) was scheduled to begin September 9, 1974.

If full production had started June 1, 1973, as planned, the staff would have had more time to produce high-quality programming. To meet every transmission deadline, however, staff members had to work 10-hour days, plus weekends. All personnel agree that this "crash" program had an adverse effect on creativity. A personnel "shakedown" period and a three-month production lead time would have helped the STD to produce more effective programming.

Personnel Problems

The STD had a hard time locating and attracting production talent. The Demonstration was scheduled for a limited duration, and the staff experienced more than a normal rate of turnover. A minimum of 21 people were needed to produce the required programs; thus, no backup positions were included on the roster to cover positions that were vacated by people who were ill or on vacation. This problem was solved by foregoing time off and by creating versatility in the staff--for instance, each staff member could perform at more than one position on the production team. However, the problem of personnel shortage was particularly acute for production engineering and resulted in less than normal time for equipment maintenance.

STUDIO DESIGN AND INSTALLATION

Ideally, the studio and transmitter in an electronic distribution system would be colocated, or as close together as possible, to avoid a long microwave or cable interconnection. Seldom, however, is colocation practical. In the STD, for example, geographic shielding was necessary to avoid signal interference at the Denver Uplink Terminal. Thus, the search for a studio location, as close to the transmitter as possible, began in early 1973. A number of locations in the Denver Area were investigated, but the Diamond Hill building occupied by the Federation of Rocky Mountain States, Incorporated was selected as the most cost-effective place to construct the facility.

The Garden Level of Building B contained approximately 8,000 square feet of unoccupied space, sufficient for a studio and associated space, as well as for the STD Network Control Center and the Origination and Delay Center of the Rocky Mountain Corporation for Public Broadcasting (RMCPB). The system was designed to include an interface between the RMCPB network (which extends to public television stations in the region) and the STD. This interface provided a production "backup" capability during satellite downtime or failure.

A lease was signed on August 16, 1973, after construction plans had been approved. The lease called for 6,500 square feet of space to be remodeled according to the plans which are appended in this report. The space allocated solely to production, equipment, maintenance, and production talent totaled 5,500 square feet.

Planning the production facility and associate space required several months of consultation, since it was a cooperative venture involving: (1) the production staff; (2) the engineering staff, who assisted with the equipment installation; and (3) the technical staff of the RMCPB network. The engineering staff was responsible for the Network Control Center, the Denver Uplink Terminal, and the ground system in the region; all these components had to be integrated into the total system.

The planning process began in June, 1973, and was completed in September, 1973. Bids were requested the same month, and a contract for the construction of the facility was signed September 26, 1973. Work began by lowering the studio floor to provide a 13-foot clearance for the studio lighting grid. The maximum studio size was approximately 35 feet by 50 feet. The STD would have preferred a larger studio size and a greater ceiling height to create dramatic production formats, but these things were impossible.

A construction management contract also was signed in September, 1973. The successful bidder coordinated the subcontracted construction which paralled the general remodeling of the facility. The initial construction contract for remodeling totaled $21,800, and the construction management fee was negotiated at five percent of the value of all construction contracts.

To prepare the specifications and plans for the electrical contract bids, the STD assessed the electrical power requirements for the entire facility and employed an electrical design consultant. The electrical contract was signed with the low bidder on October 11, 1973, after a review of all bids by the design consultant. The amount of the electrical contract was $35,000, with a $16,000 supplementary fee for installation of studio lighting contracted on December 12, 1973.

The air conditioning systems required for the studio and the equipment areas were designed by each of the contract bidders, according to a set of specifications written by production and engineering personnel. These specifications--standard in the industry--included a low-speed, high-volume system for the studio, with no more than 20 db ambient noise level. The specifications defined the expected personnel occupancy (in each area) and the amount of heat (in BTU's) produced by the equipment and lighting. The air conditioning contract was signed with the lowest bidder on September 26, 1973; the contract totaled $38,985.

Construction of the entire complex, as well as installation of all equipment, was completed March 1, 1974--approximately five months after signing the first construction contract. To complete the installation and to prepare for the programs, the production staff designed and installed the studio cyclorama and scenery; completed all talent arrangements; and made costumes for the cast.

EQUIPMENT PROCUREMENT AND INSTALLATION

The specifications for "commercial-quality" equipment were written by January, 1973.

There were two reasons for choosing commercial television standards as the quality level for equipping the production facility. First, the STD picture and sound would be compared to the best commercial television network signal. Second, a TASO-1 image quality would be required. (A TASO-1 signal has no noticeable noise degradation upon close examination; it would, therefore, be rated "excellent" by the most discriminating observer. Also, this quality level is maintained by all national television networks.)

The equipment included in bid specifications insured the production of a network-quality signal to match the design expectations of the ATS-6, as well as the entire ground system. It also provided for extensive tape editing. The following items were included in the specifications:

--Three Studio Color Cameras
--One Film-Slide Chain
--Three Two-Inch Quadrature Color Videotape Recorders
--One Time Base VTR Editing System
--One Audio System
--One Character Generator
--One Studio Lighting and Dimming System
--One Video Switcher
--One Test Equipment System
--One Monitoring, Control, and Distribution System, including Color Generators

Five people responded to the "Invitation to Bid" on new equipment in January, 1973. The bids ranged from $630,000 to nearly $700,000.

In June, 1973, the STD identified a package of broadcast-quality production equipment that was available for lease from the Levitz Furniture Company at their commercial production studio in Phoenix, Arizona. Inspection, inventory, and further investigation resulted in the leasing of this package. The package totaled $330,000 and covered a two-year period; an option to extend the lease or purchase the equipment for a negotiated price also was included in the package. The equipment had an estimated capital value of $750,000, making the lease cost amount to approximately 45 percent of the capital cost.

The leased equipment met all the requirements set down in the original bid specifications, with two exceptions. First, no film chain was included in the package. Second, the lighting equipment was not sufficient to light the studio. An additional $120,000 purchased a new film chain, studio lighting, and a character generator, as well as miscellaneous distribution equipment and monitors. The total equipment cost for the two-year period was $450,000.

Some equipment deficiencies were corrected in the shakedown period after March 1, 1973. Three replacement color cameras were leased to replace those in the equipment package which could not meet the quality standards of the rest of the equipment and could not be rebuilt in a reasonable time and at an acceptable cost. Except for normal shakedown changes (especially in the distribution system), the equipment performed adequately during the Demonstration.

In retrospect, several additional purchases would have increased the effectiveness of the production equipment. For example:

1. If the STD had purchased a two-camera film chain rather than a one-camera film chain, it would have been able to make transitions between more than one film or slide source.
2. If the STD had purchased a character generator with a greater memory or storage capacity than 16 frames (8 lines to the frame), it would have had a better production tool.
3. If the STD had included a slow motion or freeze frame capability in the system, it could have used this capability as a "teaching aid" during the production process.

To complete the equipment for the production facility, the equipment areas were provided with computer flooring. This flooring allowed the circulation of conditioned air to any equipment location and served as a wireway for power and component links. Also, a compressed air system was built to supply the six VTR's in production and at the Origination and Delay Center; an emergency lighting system was purchased as a safety device in the event of an emergency involving power failure; and the electrical contract included an electronic fire detection and alarm system.

EQUIPMENT MAINTENANCE PLANS AND EXPERIENCE

Electronic equipment maintenance was divided into three categories: (1) daily maintenance and adjustment; (2) preventive maintenance; and (3) equipment failure maintenance. Failure maintenance relates directly to the amount of preventive maintenance employed. In the STO, it would have beeen desirable to invest 1-1/4 man days in daily and preventive maintenance for each production day, but staff time and manpower was not sufficient to maintain this ideal ratio in the face of high production schedules. A ratio of one man day of maintenance and setup time to each production day was maintained during the Demonstration. This ratio was sufficient to keep the system operational.

CONCLUSIONS ANO RECOMMENOATIONS

Considering the short lead time which was built into the Demonstration, the pressure from deadlines was inevitable. The problem was compounded by the lengthy decision-making process that was inherent in the Project: The decision-makers at the federal level were remote from the operational staff who implemented their decisions.

The STO recommends the following to future planners of telecommunications projects:

1. Specify a personnel shakedown period, with no scheduled production for 30 to 60 days, and a production lead time of at least three months. The STO did not have time for these shakedown periods; as a result, its "accelerated" program had an adverse effect on creativity.
2. Delineate job qualifications, in-detail, and measure job applicants against required skills. The STO wrote out job descriptions for each production staff member before hiring began. In retrospect, however, the STO should have spend more time in detailing job descriptions and in measuring applicants against required skills. Much post-employment training could have been avoided by this procedure.
3. Using engineering drawings, specify equipment and interconnecting cable locations before the start of installation. The STO's equipment plans and installation procedures were adequate, but detailed documentation of the system was not complete until the conclusion of the Project. Fortunately, the STO installation engineers worked closely with production personnel who were

charged with operating the system; this relationship helped to insure that the equipment was installed properly, even though no detailed specifications were available. In the future, however, one person should supervise all engineering tasks--including planning, installation, and production--throughout the life of the project.

4. Set aside office space (on one floor) for all production and engineering personnel; make sure this office space is close to the production area. If all STD personnel who were in charge of production, engineering, and content development had been placed on one floor adjacent to the production area, the STD could have increased involvement and improved communications among Project members.

5. Design a studio that is at least 50 feet by 50 feet, with a ceiling height of 20 feet. The STD studio was too small for dramatic productions. No space was available for set storage, and the greatest liability to efficient production was the lack of adequate ceiling height. A studio for similar productions should be, at a minimum, 50 feet by 50 feet, with a ceiling height of 20 feet; or, ideally, 80 feet by 80 feet, with a ceiling height of 20 feet.

6. Consolidate all production and engineering responsibilities. Engineering responsibilities in the STD were, by design, separate from production responsibilities. This separation grew out of the need to construct and coordinate terminals in 20-plus states and to meet federal deadlines. In the future, however, these responsibilities should be consolidated to insure not only less duplication in facilities and equipment, but also more efficiency in related activities, such as purchasing.

If there is one lesson, here, for future planners, it is the need for ample time: Most of the above recommendations are steps the STD would have taken, if it had not been operating under such rigid time schedules. The benefits of ample time for planning, installing, and maintaining production facilities and equipment may be minimal in the short term. But the benefits of time in terms of economy and efficiency are unquestionable in the long term.

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APPENDIX I

GARDEN LEVEL PLAN

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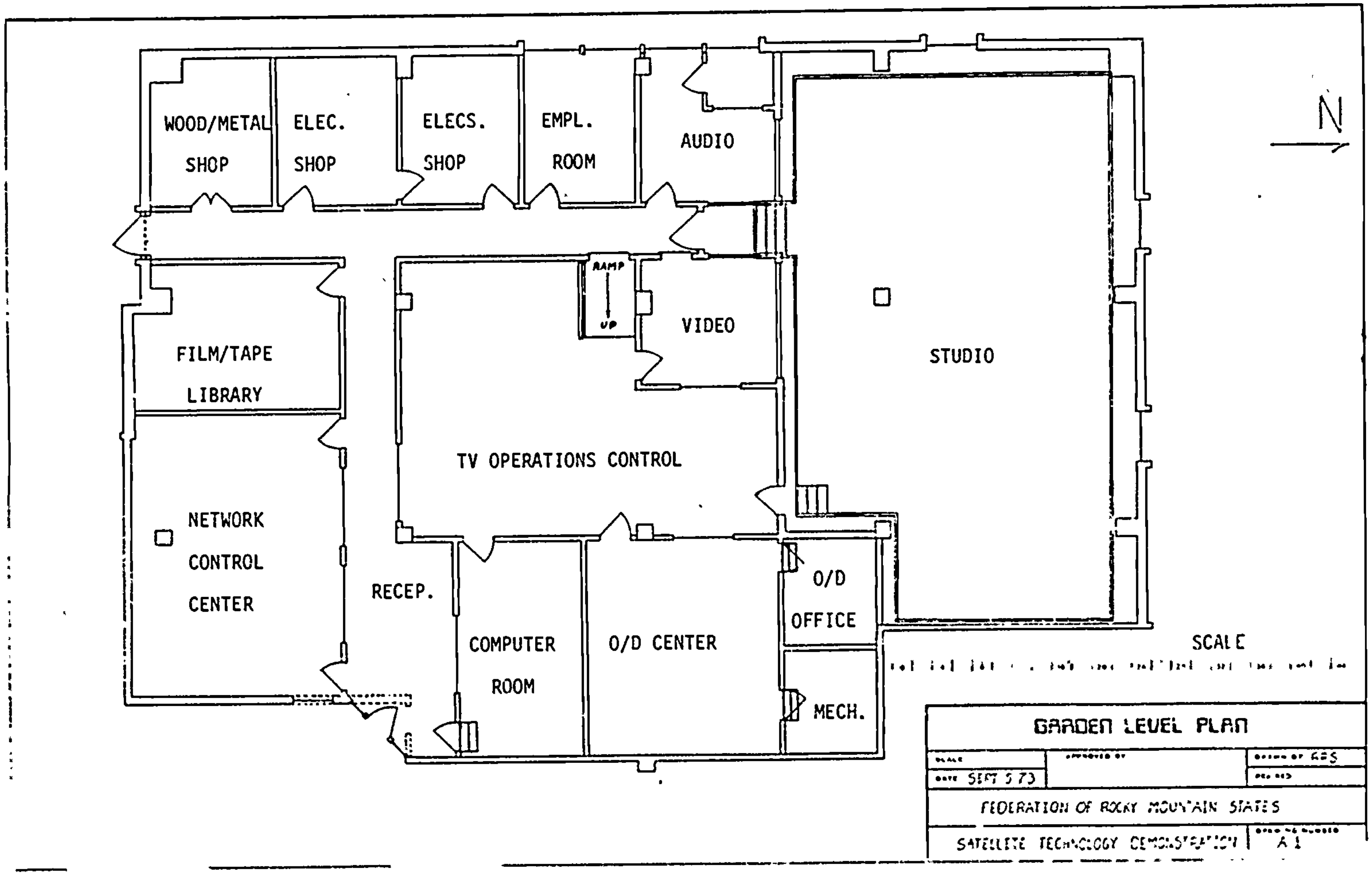
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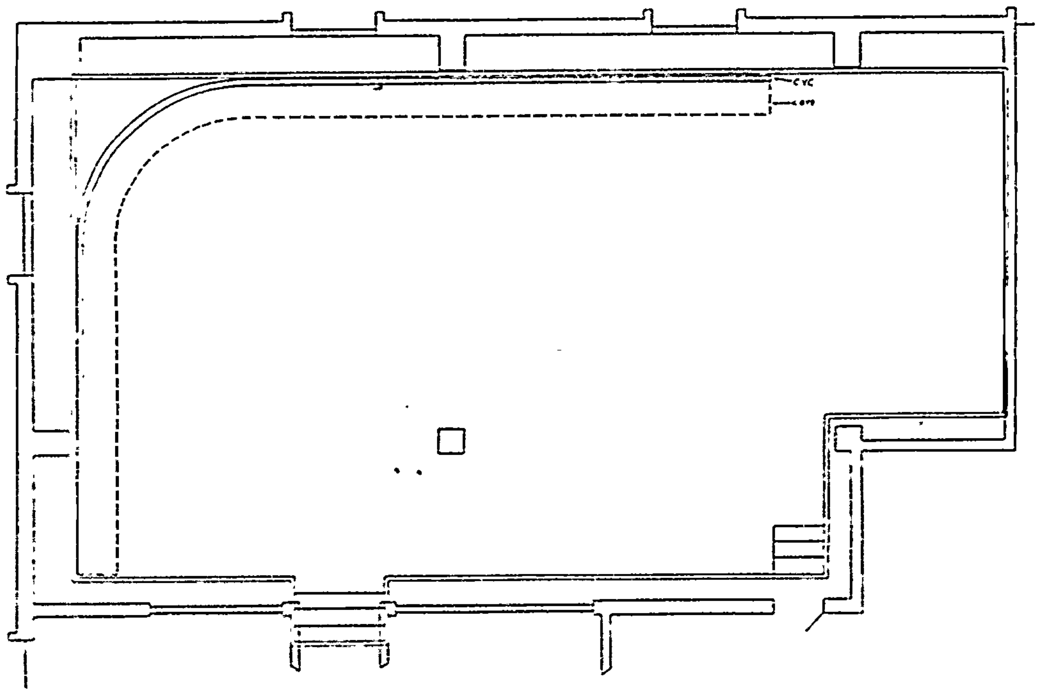
APPENDIX II

STUDIO DETAIL



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