

Southern California Rapid Transit District  
Metro Rail Project

Analysis of  
Fireproofing Repairs  
to Main Shop Building  
Contract A112  
November 14, 1989

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I. EXECUTIVE SUMMARY

The Main Yard and Shops Building, Contract A-112, is nearing completion. Several problems were identified arising from the application of the fireproofing throughout the building. The two fundamental problems which this report addresses are:

1. The quality of the spray-on application and the existing condition of the fireproofing.
2. The aesthetic appearance of those portions of the building where the fireproofing is exposed to view and subject to damage.

This report identifies areas that can be rectified with minor modifications and others that need major repairs. Each area is addressed separately with a description of its condition and a recommended repair.

The last part of this report contains a suggested scope of work for a remedial contract concerning removal, and disposal of fireproofing, repair and protection of the existing fireproofing material.

In recent telephone conversations with the Resident Engineer, we have learned that the contractor has moved to repair the damaged or "out of spec" sprayed-on fireproofing. We do not know the final condition of the fireproof application and expect this to be documented in the Final Acceptance Report by the Construction Manager.

If the recent spray-on repairs to the original application are acceptable to the District, then the quality issue has been addressed and the scope of work for a separate removal and disposal diminishes. MRTC estimates the construction cost of removal and disposal of fireproofing, as well as modifying the existing finishes and architectural treatments to be approximately \$150,000.00.

## II. BACKGROUND

The Metro Rail Main Shop Building, Construction Contract No. A112, located on Santa Fe Avenue is being constructed by Illinois Walsh Construction Company. The building frame and some of the steel decks are required to be protected by 2-hour rated fireproofing. The contract specifications section 07250 allows the use of either mineral fiber-type or cementitious-type fireproofing. The Contractor selected Cafco "Blaze Shield," a mineral fiber-type fireproofing permitted by the specifications, for use on the project.

Three kinds of damage have occurred to the fireproofing since its application: removal by other trades to install clips, and hangers; sections of roof deck fireproofing falling away; and impact damage to those fireproofed items that were not protected below 8 feet from the floor.

The first two kinds of damage resulted from the Contractor electing to not follow the contract specifications and the manufacturer's literature concerning proper application procedures. Both clearly state that no fireproofing should be applied before all miscellaneous "hangers, inserts, clips and other attachments are installed." The manufacturers' technical specifications further require that "application to the underside of roof deck assemblies shall be done only after roofing applications is complete and roof traffic has ceased." These recommendations were not followed by the contractor who also allowed suspended mechanical equipment and duct work to be installed prior to the application of the fireproofing making it difficult to achieve adequate coverage. This is also prohibited in the contract specifications and the manufacturer's literature.

Of particular concern regarding the bond failure of the fireproofing to the roof deck is the manufacturer's literature requirement that a "bonding adhesive shall be applied to underside of steel roof deck units which do not have a concrete topping. . ." The contract specifications are mute about this; but, like the manufacturer's literature, we require the subcontractor be a "manufacturer approved applicator" who would be familiar with the need to use a bond adhesive to warranty the product application.

The final fireproofing damage resulted from the application of this friable material without protection or cladding in areas low enough to be reached by the various workers erecting

the shop building. The drawings and specifications do not describe any means of protection to prevent this damage which will continue once the building is accepted and becomes operational. The '79 edition of the Uniform Building Code (the edition in effect when this building was being designed) requires that fireproofed columns be protected where they are "exposed to injury from moving vehicles, the handling of merchandise or other means (UBC 4303(b)5)". The columns are encased in concrete to a height of 8 feet at the 1st floor throughout the building. The same cannot be said about any K-brace location or exposed columns at subsequent floor levels.

### III. QUALITY OF THE SPRAY-ON APPLICATION

A room by room inspection of the Main Shop Building was made and the following additional items were noted:

- A) The fireproofing exposed on the structural frame seems adequately adhered; however, since it is exposed and extremely friable, it requires protection from future damage.
- B) The fireproofing on the underside of the 2nd floor concrete filled steel deck is intact and no bonding failures were noted. This is likely the result of the concrete filled steel decks being less flexible than the unfilled roof decks.
- C) Miscellaneous repairs have been made to the damaged fireproofing with a different material (a cementitious-type thought to be Monokote). There are no U.L. test results showing the performance of structural members with two kinds of fireproofing so there is technically no rating for members fireproofed in this manner.
- D) In many locations the fireproofing was applied much thicker than required by the U.L. design.
- E) Fireproofing in high bay shops is covered with dirt and dust from a combination of being exposed in an open building for so long and the repeated excavations required by the car body hoist footings. While it may not affect the performance of the fireproofing, the appearance is not aesthetically pleasing.
- F) The exfoliation of the mineral wool fibers where no ceiling is present or where the suspended acoustic ceiling is routinely opened, presents some hazard to computers and electrical equipment. The possibility of surface stabilization by a through saturation of a sealer exists, but with a less dilute mixture applied in greater amounts than usually recommended by the manufacturer.

IV. REMEDIAL WORK TO PROTECT AND ENCLOSE EXPOSED FIREPROOFING

With the above issues in mind, and realizing the need for providing a quality product that satisfies the requirements of the client for the service life of the building, we make the following recommendations for remedial fireproofing work at the main shop building:

A. The Exterior K-brace Below The Yard Control Tower on Gridline 1A:

Condition:

This is presently fireproofed with mineral fiber-type fireproofing providing 2-hour protection and untreated architecturally.

Recommended Repair:

The mineral fiber-type fireproofing should be entirely removed. The Fire/Life Safety Committee has allowed a reduction to 1-hour fire protection so the K-brace can be protected with any of the following Underwriters Laboratory fire resistance directory design numbers: X-601, X-607, X-608, X-612, X-618, X-619, or X-620. These are assemblies which involve applying some kind of wire mesh flange reinforcement and then multiple spray-on coats of a solvent based mastic to achieve the required design thickness. The material can be dressed smooth with a trowel to approximate the appearance of a rolled structural tee and once it is fully cured (a period of 6 weeks), painted to match the exterior of the building (Photos Nos. 72, 73).

B. Blowdown Facility (Room Number 157):

Condition:

The entire structural frame and steel roof deck is fireproofed with mineral fiber-type fireproofing providing 2-hour protection. All of the fireproofing is exposed.

Recommended Repair:

The K-braces on gridline A must be covered with a gypsum board finish for a height of 8'-0" from the floor. The miscellaneous conduits, surface mounted light fixtures,

rainwater leaders, and sprinkler system drain lines that occur on or near K-braces will have to be handled by enclosing or relocating the service to the new face of finish. (Repair Type III.) (Photos Nos. 1, 2, 3, 4.)

The columns and K-braces on gridline A.7 that project through the existing rated gypsum board wall finish shall have a new full height gypsum board wall constructed in front to enclose the fireproofing. Electrical services and sprinkler test lines shall be extended to the surface of the new wall. (Repair Type V.) (Photos Nos. 5, 6, 7, 8.)

The columns at the telescoping door jambs on gridlines 1.1 and 10 shall have the existing sprayed fiber-type fireproofing removed and resprayed from floor to ceiling with a cementitious-type fireproofing. A compatible hard surface coating shall be applied over the fireproofing to provide moisture protection and further resistance to impact damage. The surface mounted door controllers will require relocation to the finished surface of the new fireproofing. The surface mounted conduit can remain in place and be covered by the fireproofing.

All the existing fiber-type fireproofing on the roof trusses, bottom chord diagonal bracing, purlins, and roof deck between gridlines 2.7 and 10, must be sprayed with a sealer compatible with the mineral fiber-type fireproofing. (Photos Nos. 9, 10.)

C. Rail Control Center (Room Nos. 243, 244, 245, 248 & 249) and Yard Control (Room No. 401):

Condition:

All rooms have gypsum board walls that enclose the perimeter columns and K-braces so there is no exposed fireproofing at these locations. Room 249 has free-standing columns on gridline F.6 that have exposed fireproofing above the 12'-0" high gypsum board furring. With the exception of Communications Equipment Room No. 249, these rooms have suspended acoustical ceilings below the fireproofed steel roof deck and beams. The fireproofing on the roof deck and beams in Room 249 is exfoliating.



Recommended Repair:

The freestanding columns in Room 249 must be protected by a gypsum board finish on steel studs. The roof deck and beams in Room 249 must be sprayed with a sealer to eliminate exfoliation.

D. Equipment Rooms in Control Tower (Room Nos. 279 and 303):

Condition:

The fiber-type fireproofing on columns and K-braces that project through the face of the rated C-H stud perimeter walls, on the steel deck, and supporting beams is exposed.

Recommended Repair:

The fireproofing on the columns and the K-braces must be protected by full height gypsum board walls and the steel deck and beams sprayed with a sealer. (Similar to Repair Type V.)

E. Elevator Hoistways:

Condition:

All three locations have mineral fiber-type fireproofing exposed on the beams framing around floor or roof penetrations, the guiderail support framing, and the steel roof deck of the hoistways.

Recommended Repair:

A gypsum board finish over metal furring must be installed at the floor or roof penetrations to enclose the existing fireproofing. The guiderail support framing should be cleaned of fireproofing and left bare, since there is no code requirement for these structures to be protected. The roof deck fireproofing must be covered by a suspended gypsum board ceiling that does not diminish the required top of car clearance for the elevators.

F. Miscellaneous Repair Shops, Cart Storage, Mechanical Equipment Rooms and Traction Power Substation

Condition:

All of these areas have mineral fiber-type fireproofing exposed on columns and K-braces, steel deck, and supporting beams.

Recommended Repair:

The K-bracing must be encased in gypsum board on metal furring to height of 8'-0" from finish floor. (Repair Type III.) The existing fireproofing on the steel and supporting beams must be sprayed with a compatible sealer.

G. Second Floor Future Expansion Areas (Room Nos. 273, 276, 277 & 278):

Condition:

All of the areas have exposed mineral fiber-type fireproofing on columns and K-bracing that project through the rated gypsum board wall finish and on the steel deck and supporting beams.

Recommended Repair:

The exposed K-braces must be covered by a new, full height gypsum board wall and existing electrical outlets must be extended to the new finish surface. The existing fireproofing on the steel roof deck and supporting beams must be sprayed with a sealer compatible with the mineral fiber-type fireproofing. (Repair Type V.) (Photos Nos. 21, 22, 23.)

H. High Bay Shops: Heavy Repair (No. 124); Service/Inspection (Number 156):

Condition:

Exposed mineral fiber-type fireproofing is on columns and K-braces along gridlines B and C in Service/Inspection and gridlines D, E, and F in Heavy Repair. Exposed fireproofing also exists on the overhead telescoping door

jamb on gridlines 5 and 20 and the roof trusses, bottom chord bracing, and purlins.

Recommended Repair:

In Service/Inspection the K-braces on gridlines B and C must receive a new gypsum board finish, extending to 8'-0" above finish floor. Miscellaneous conduits, surface mounted light fixtures, rain water leaders and sprinkler system check valves occurring on or near K-Braces will have to be handled by enclosing or relocating the service to the new face of finish. (Repair Type III.) (Photos Nos. 42, 43, 44, 45, 46, 47, 48.)

The K-braces on gridlines D and F in the Heavy Repair Shop shall receive the gypsum board finish extending to 8'0" above finish floor. (Repair Type III. Photos Nos. 24, 25, 26, 27, 28, 29, 30, and 31.)

At gridline E in the Heavy Repair Shop, the columns and K-braces must be stripped of the existing fireproofing and resprayed with a cementitious-type fireproofing. The columns shall be sprayed from above the concrete encasement to the roof deck, and the K-bracing from finish floor to the bottom chord of the roof trusses. A compatible hard surface coating shall be applied over the fireproofing to provide further resistance to impact damage. This coating shall cover all fireproofing at gridline E from its lowest point of application to the height of the crane rail above. Surface mounted light fixtures, electrical outlets and fire hose cabinets and these will have to be relocated to the surface of the new finish. (Photos Nos. 32, 33, 34.)

On gridlines 5 and 20 the columns at the overhead telescoping door jamb need to be stripped of the existing fireproofing and resprayed with a cementitious-type fireproofing full height from floor to roof deck. A compatible hard surface coating shall be applied over the fireproofing to provide moisture protection and further resistance to impact damage. The surface mounted door controllers will require relocation to the finished surface of the new fireproofing. The conduit can remain in place and be covered by the fireproofing. (Photos Nos. 49, 50.)

The roof deck does not require fireproofing by code because of the height above finish floor, but the trusses, bottom chord bracing and purlins do. The existing fireproofing must be sprayed with a compatible sealer. (Photos Nos. 35, 36, 37, 38, 39, 40, 41.)

I. Interior Stair Wells:

Condition:

All seven locations have exposed mineral fiber-type fireproofing on the undersides of the stair landings at the second and third floor levels (no fireproofing at intermediate landings) and on the framing around the floor openings.

Recommended Repair:

Install a gypsum board finish ceiling to the underside of floor landings. Extend fire sprinklers to the new face of finish. Where the framing is exposed at the floor openings in the stairwell, provide gypsum board finish on metal furring to protect fireproofing. (Photos Nos. 51, 52, 53.)

J. First and Second Floor Offices, Training Rooms, Lunch Room, Corridors and Systemwide Stores (Room No. 134):

Condition:

These rooms have gypsum board walls covering the existing fireproofing on columns and K-braces with the exception of Systemwide Stores which has exposed mineral fiber-type fireproofing on columns and K-braces on gridlines F.6 and G. Suspended acoustic ceilings cover the fireproofing on the steel deck and beams in all rooms.

Recommended Repair:

In Systemwide Stores on gridline F.6, remove metal cage from Tool Room No. 131 and construct a full height gypsum board wall and column furring at both sides of K-brace. At the other two locations on gridline F.6, construct similar full-height gypsum board finishes on metal stud furring to totally enclose columns and K-braces. At single columns provide gypsum board finish on metal studs

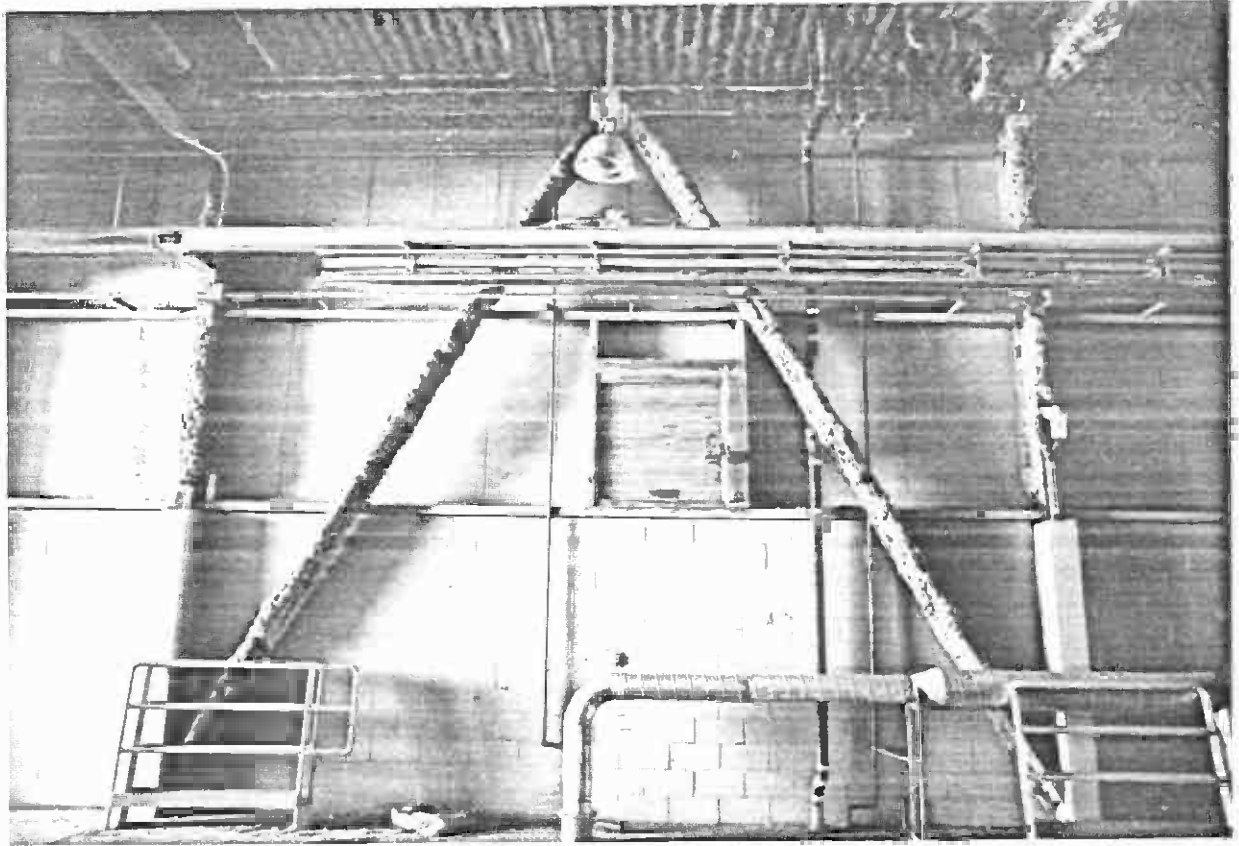
above concrete encasements to steel deck above. (Repair Type IV.) (Photos Nos. 54, 55, 56, 57, 58, 65, 66, 67, 68, 69, 70, 71.)

There are columns and K-bracing along gridline G in Systemwide Stores with exposed mineral fiber-type fireproofing that have been touched up with a cementitious-type fireproofing. Provide gypsum board finish on metal stud furring for columns from top of concrete encasement to steel deck above. At the K-braces provide the same gypsum board finish from finish floor to steel deck. Where columns and K-braces span across windows, the gypsum board finish shall enclose all four sides. (Repair Type II.) (Photos Nos. 59, 60, 61, 62, 63, 64.)

V. SCOPE OF WORK

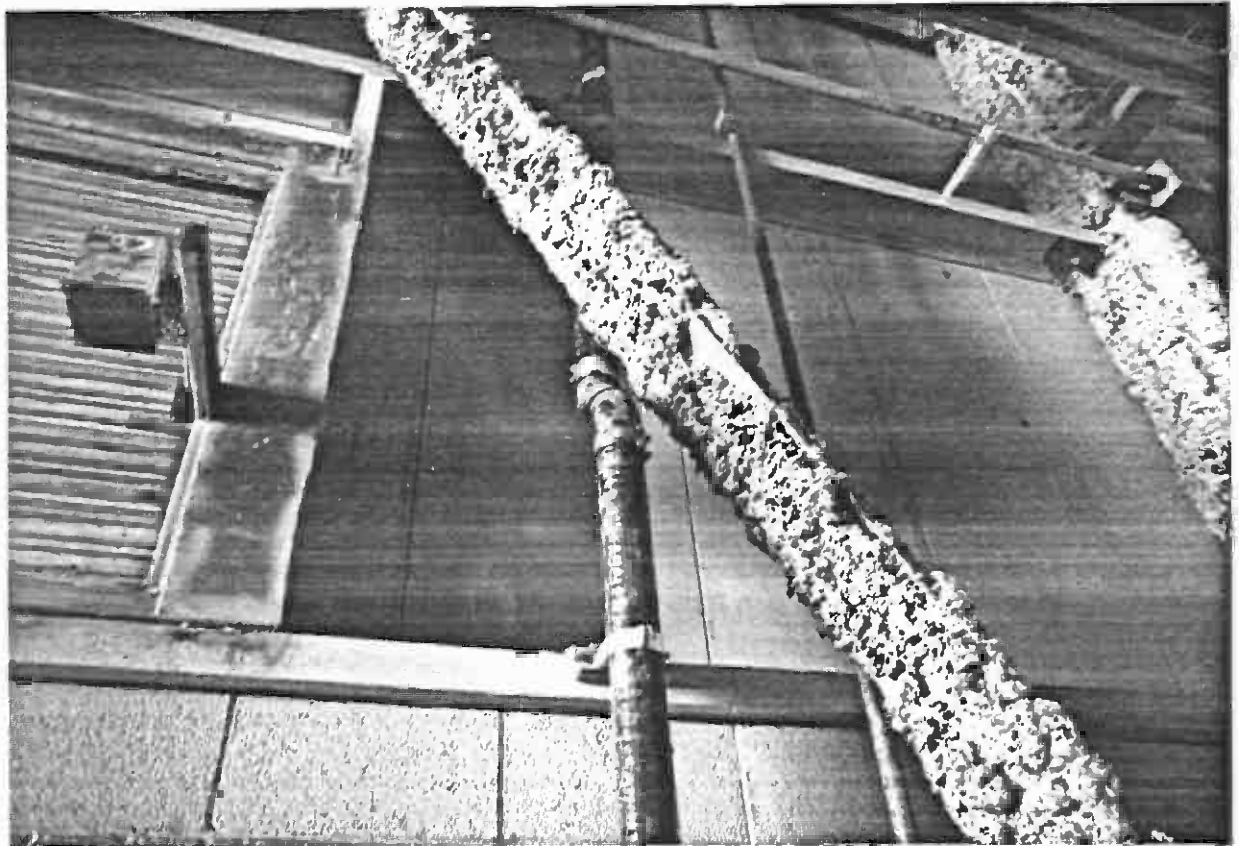
A. Removal, Disposal, Repair and Protection Contract

1. Remove mineral fiber-type fireproofing from telescoping door jambs; columns and K-braces at gridline E, exterior K-brace at gridline 1-A and the guiderail supports in the elevator hoistway.
2. Protect adjacent finishes from damage.
3. Dispose of fireproofing, leave areas swept and vacuumed.
4. Spray cementitious-type fireproofing (as well as bond coat if required by fireproofing manufacturer) to columns at jambs of overhead telescoping doors; and columns and K-braces at gridline E. Apply a compatible hard surface coating over fireproofing.
5. Apply solvent base mastic-type fireproofing to exterior K-brace at gridline 1.A.
6. Spray a surface sealer on exposed fireproofing at steel decks, trusses, diagonal bottom chord bracing, beams and purlins.
7. Construct new gypsum board walls and column/K-brace furring to protect existing fireproofing to remain.
8. Extend electrical switches, outlets, and surface mounted lights to face of new gypsum board of fireproofed finishes. Extended fire sprinkler drain lines to face of new finishes.
9. Construct new gypsum board ceilings.
10. Paint new gypsum board finishes to match adjacent areas.



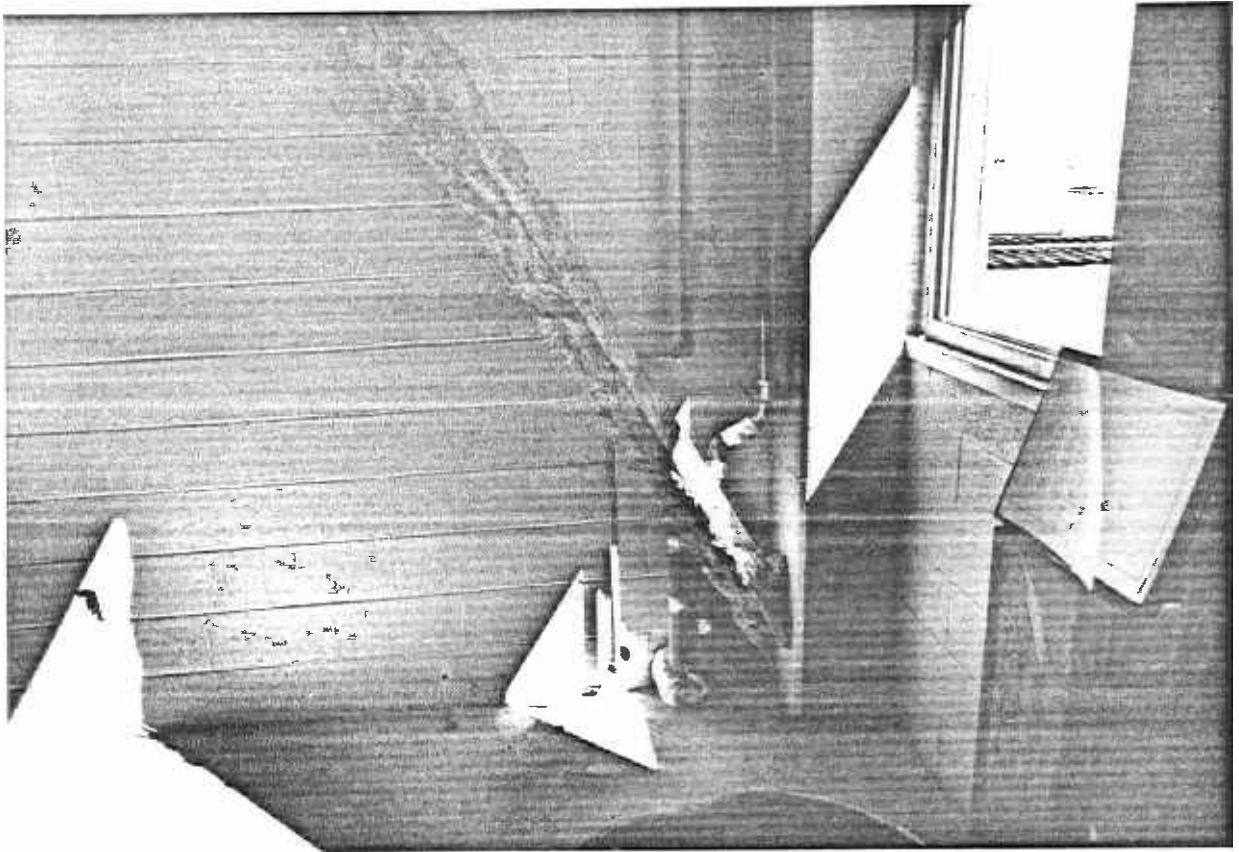
RM. 157- COLUMNS & K-BRACING AT GRIDLINE A-3 & A-4

1



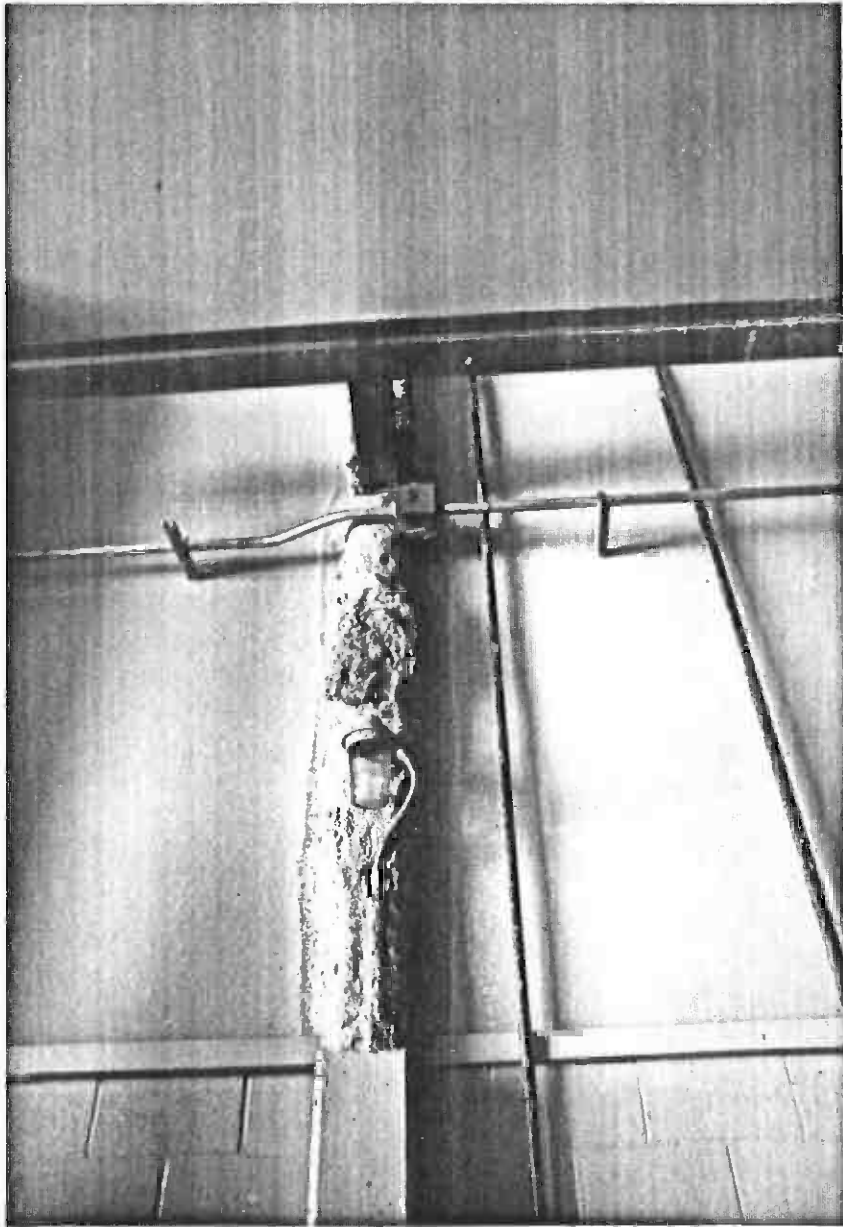
RM. 157- K-BRACING AT COLUMN A-4. ROOF DRAIN BEHIND K-BRACE.

2

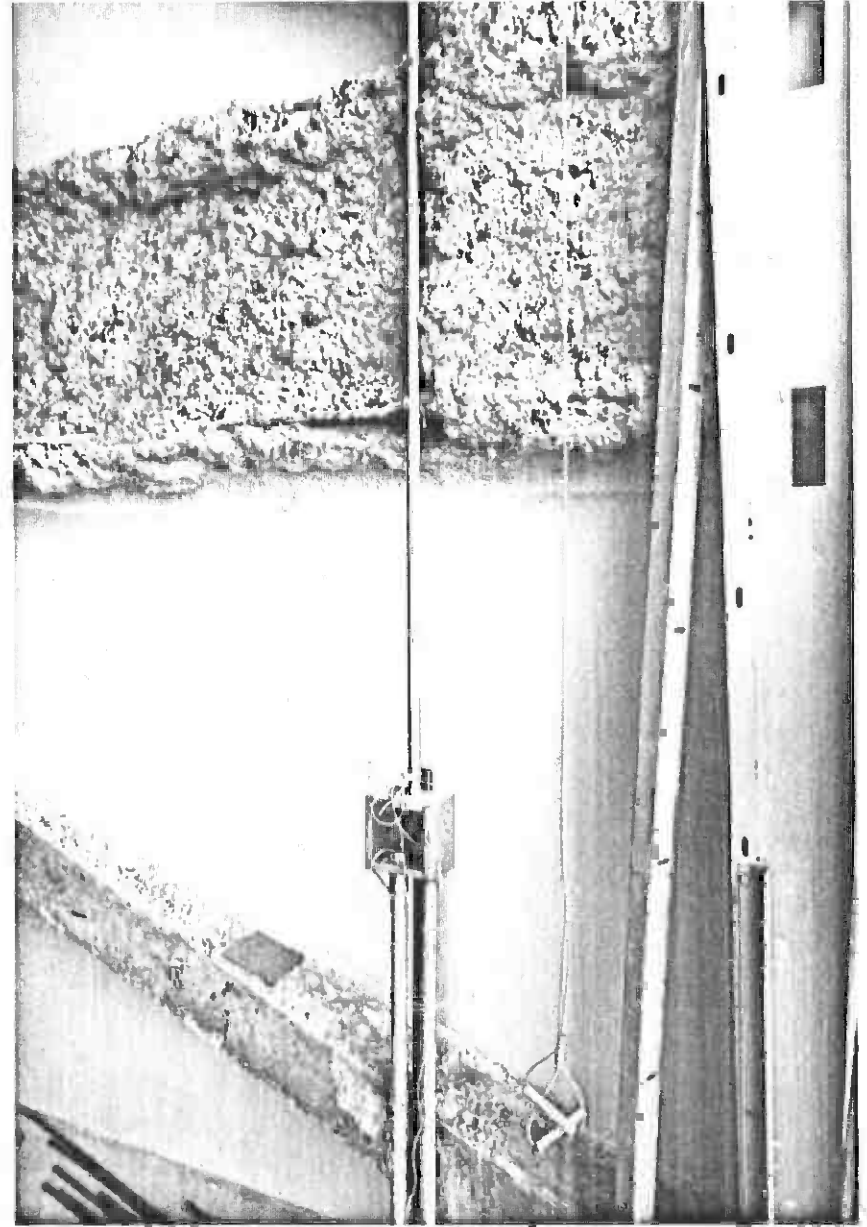


RM. 157- K-BRACING AT COLUMN A-10.

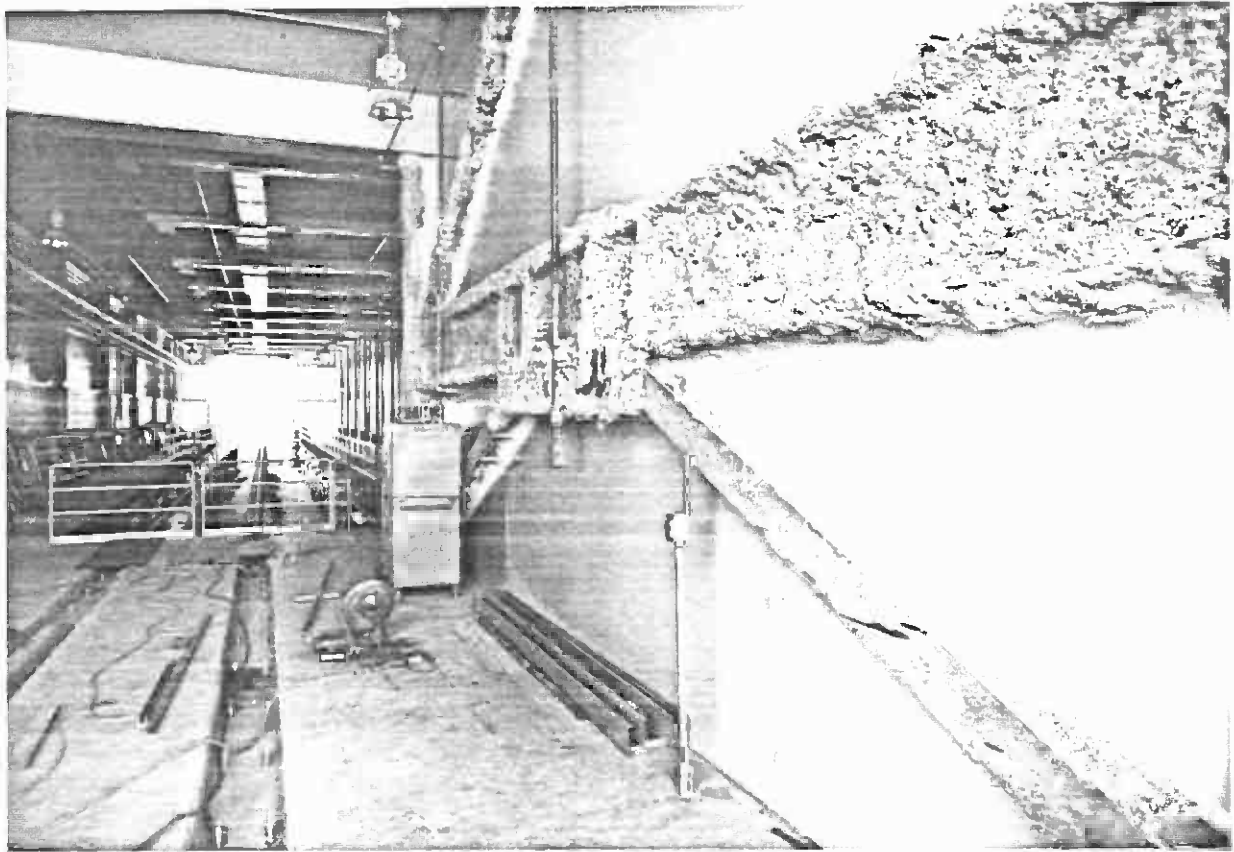




RM. 157- COLUMN A-2 W/ TYPICAL SURFACE MOUNTED LIGHT. 5

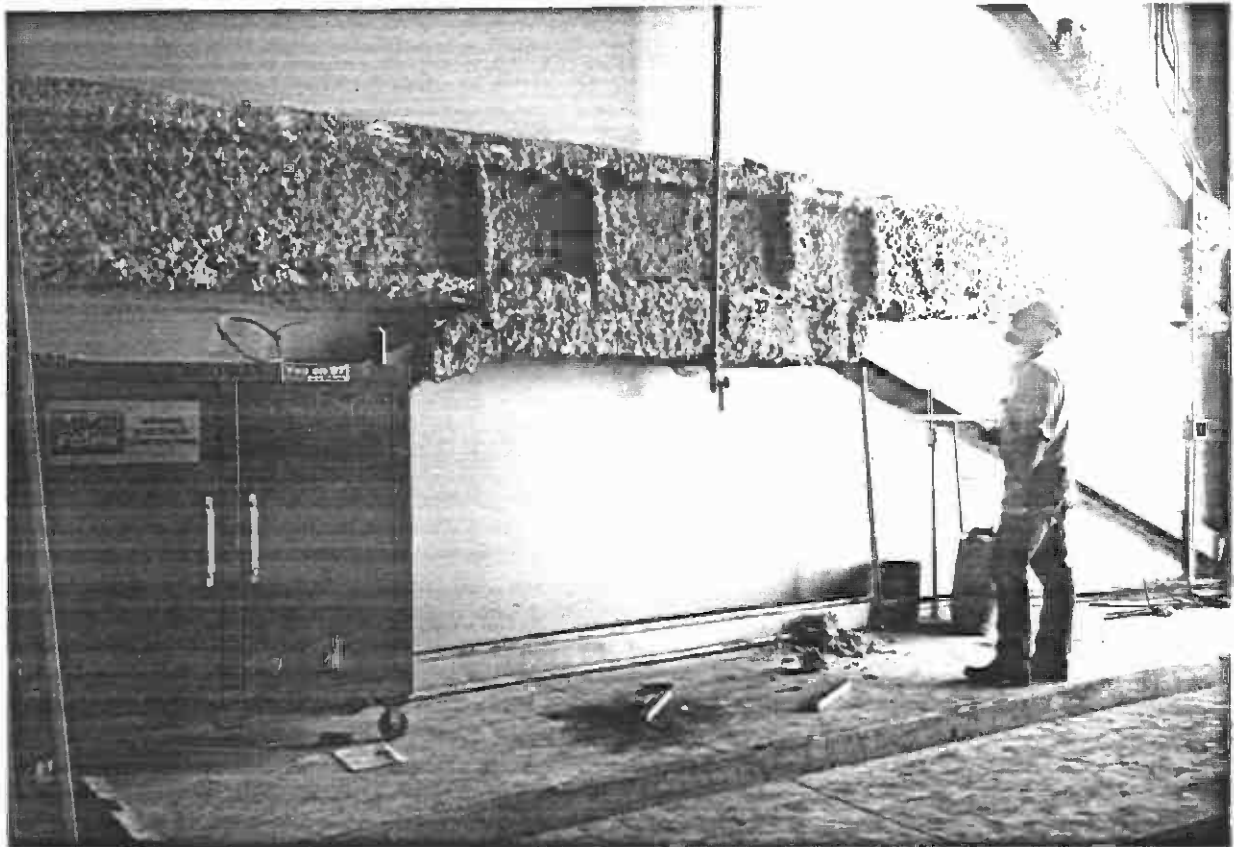


RM. 157- DOOR JAMB AT GRID A.7-1 ADJACENT TO BRACING. 4



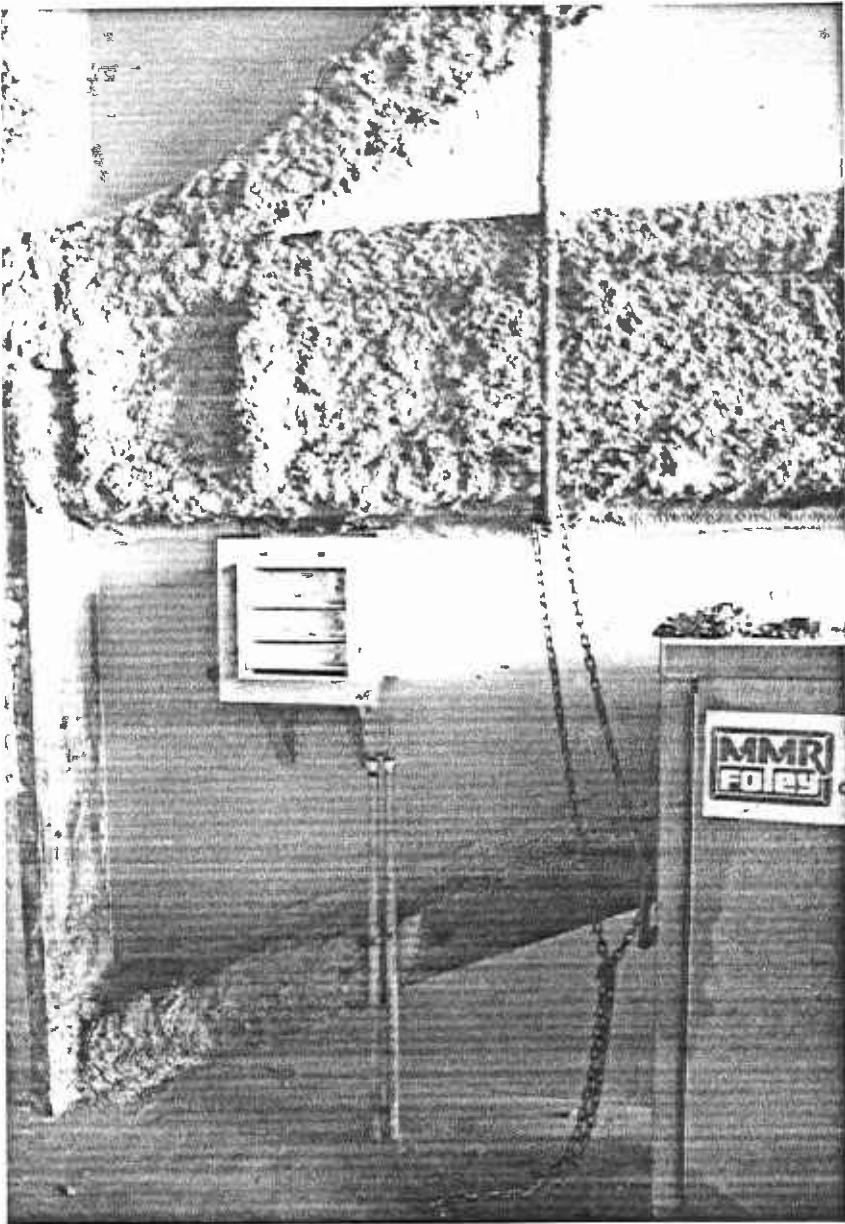
RM. 157- K-BRACING AT GRIDLINE A.7.

6

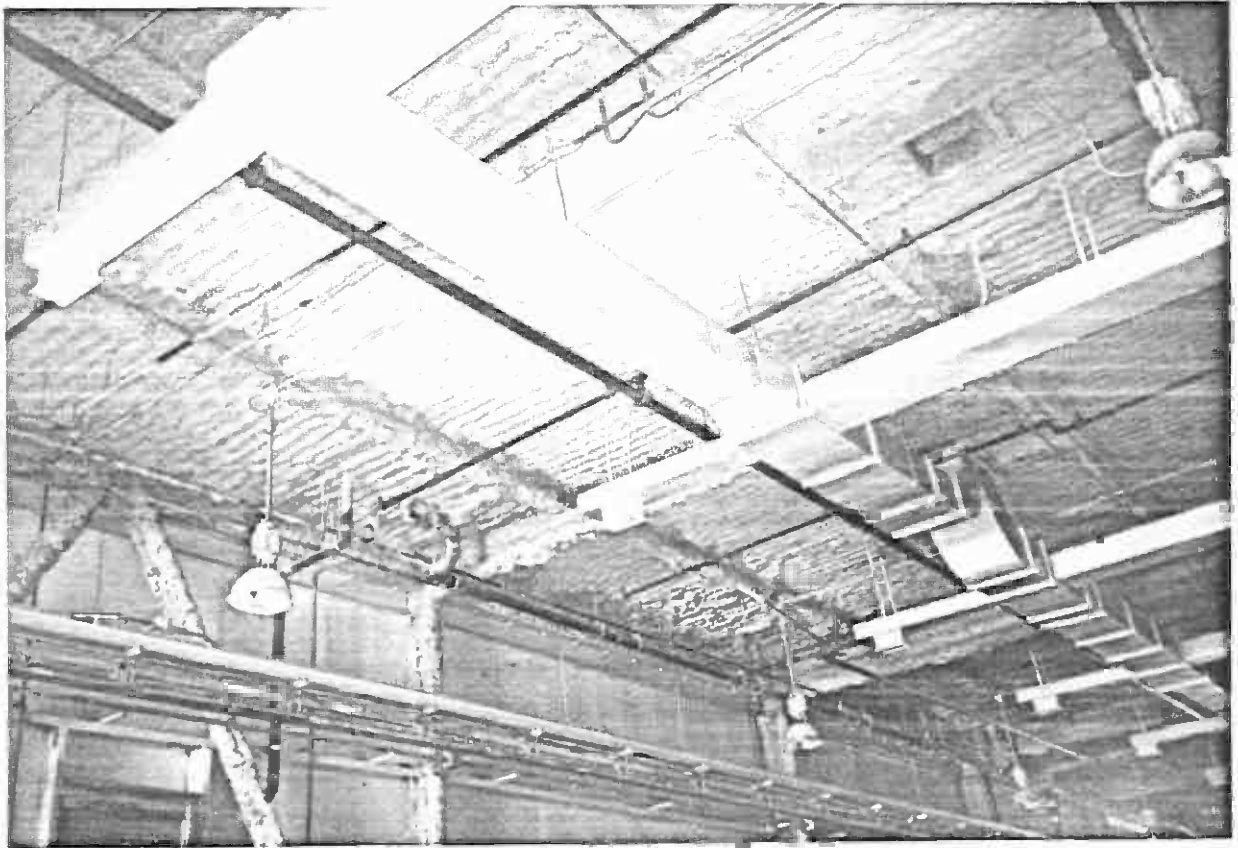


RM. 157- K-BRACING AT GRIDLINE A.7.

7

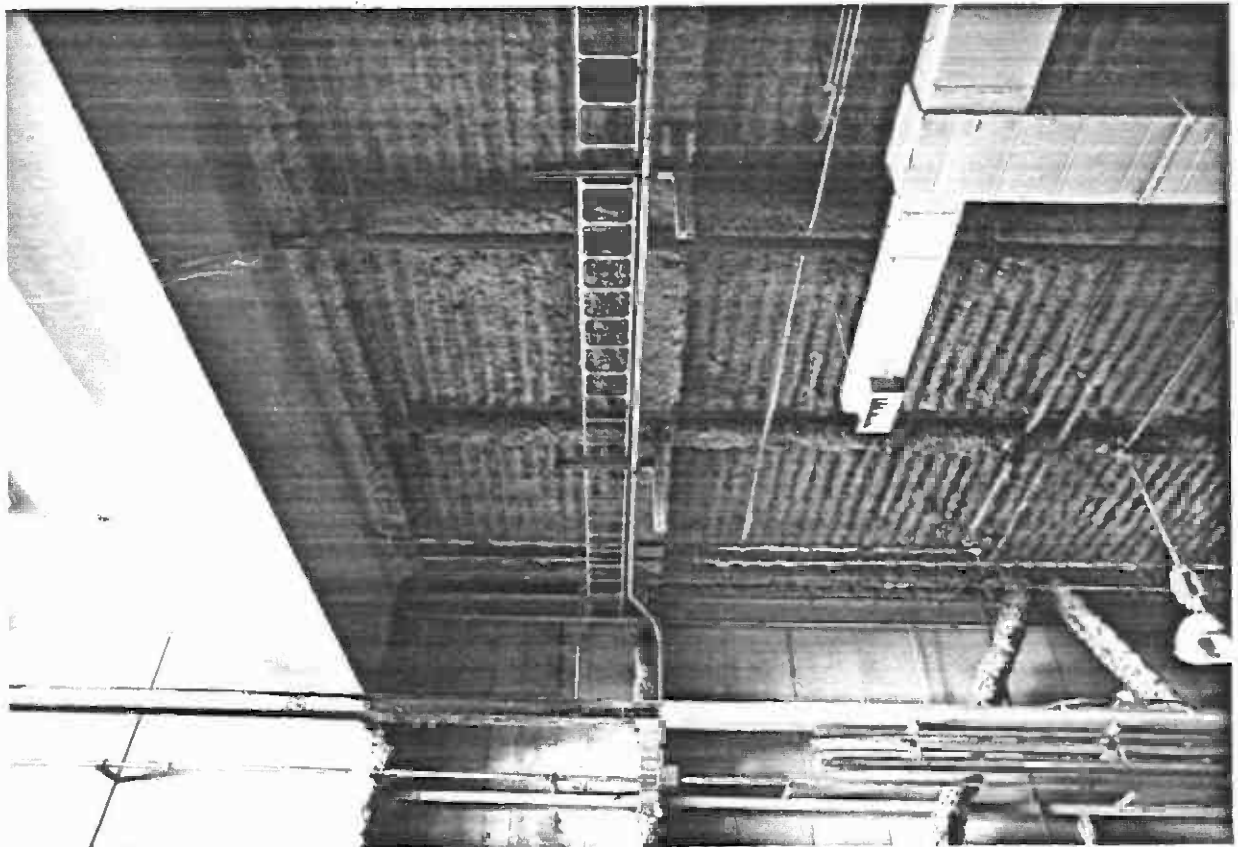


RM. 157- COLUMN & K-BRACING AT GRIDLINE A7-27.



RM. 157- EXPOSED ROOF DECK.

9



RM. 157- EXPOSED ROOF DECK

10



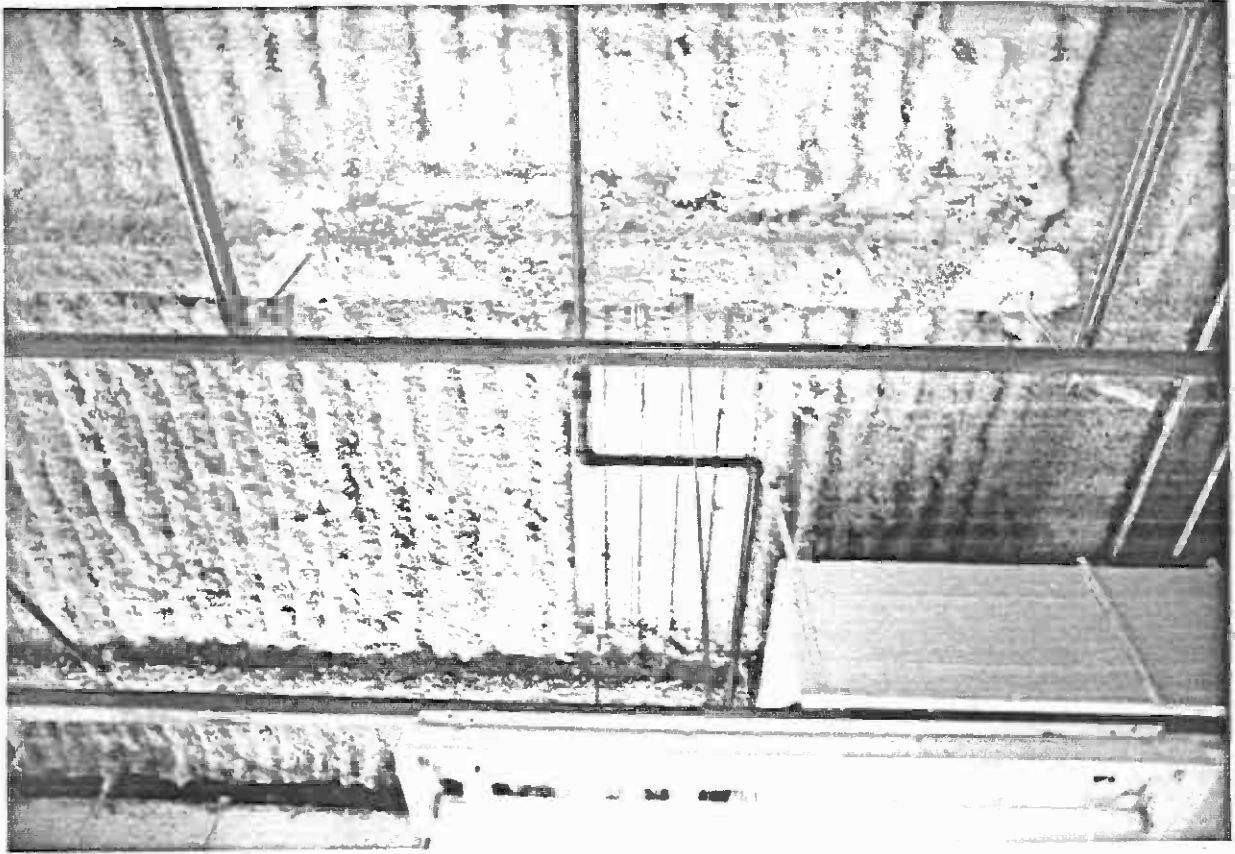
RM. 245- GWB WALL FINISH W/ SUSPENDED ACOUSTICAL CEILING.

11



RM. 249- ROOF DECK FIREPROOFING PATCHED WITH MONOKOTE.

12



RM. 249- EXPOSED ROOF DECK W/ FIREPROOFING MISSING.

13

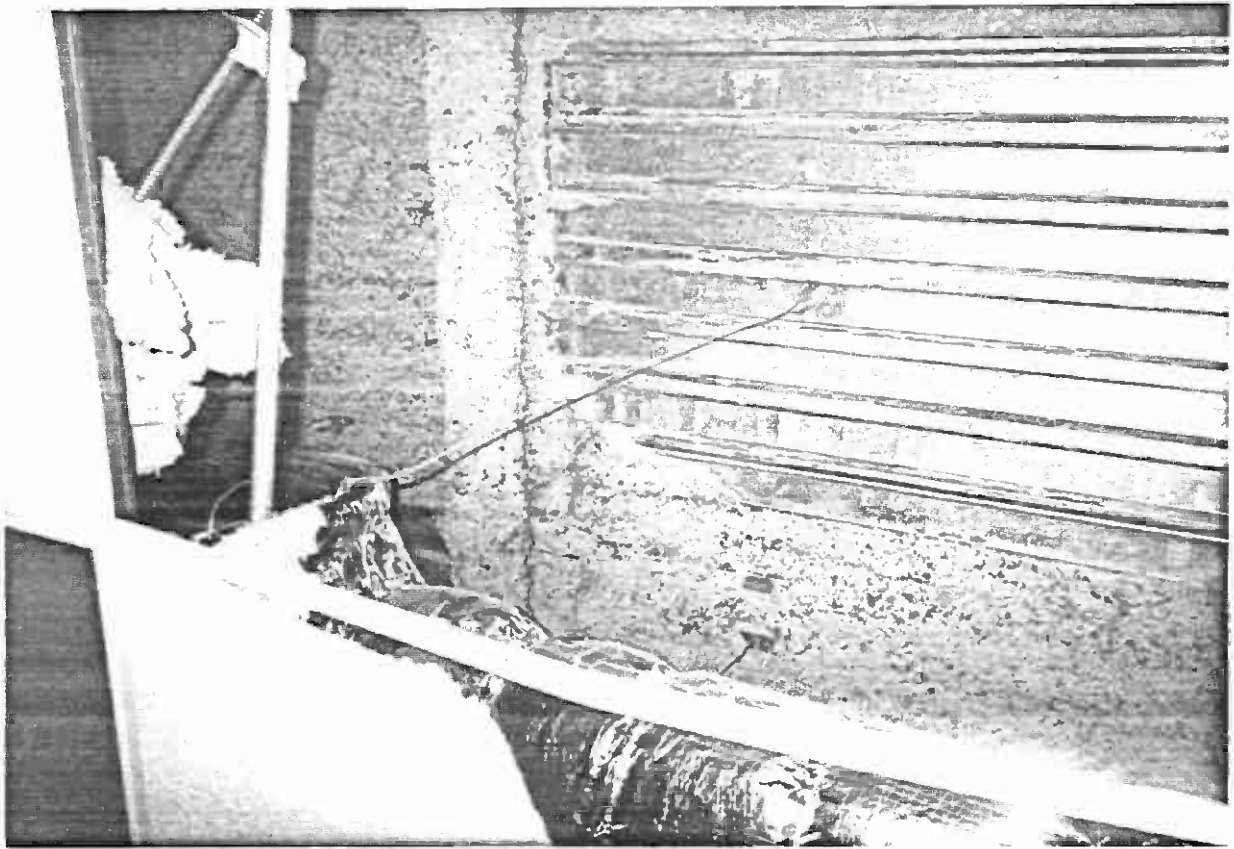


RM. 249- FIREPROOFING ON FLOOR.

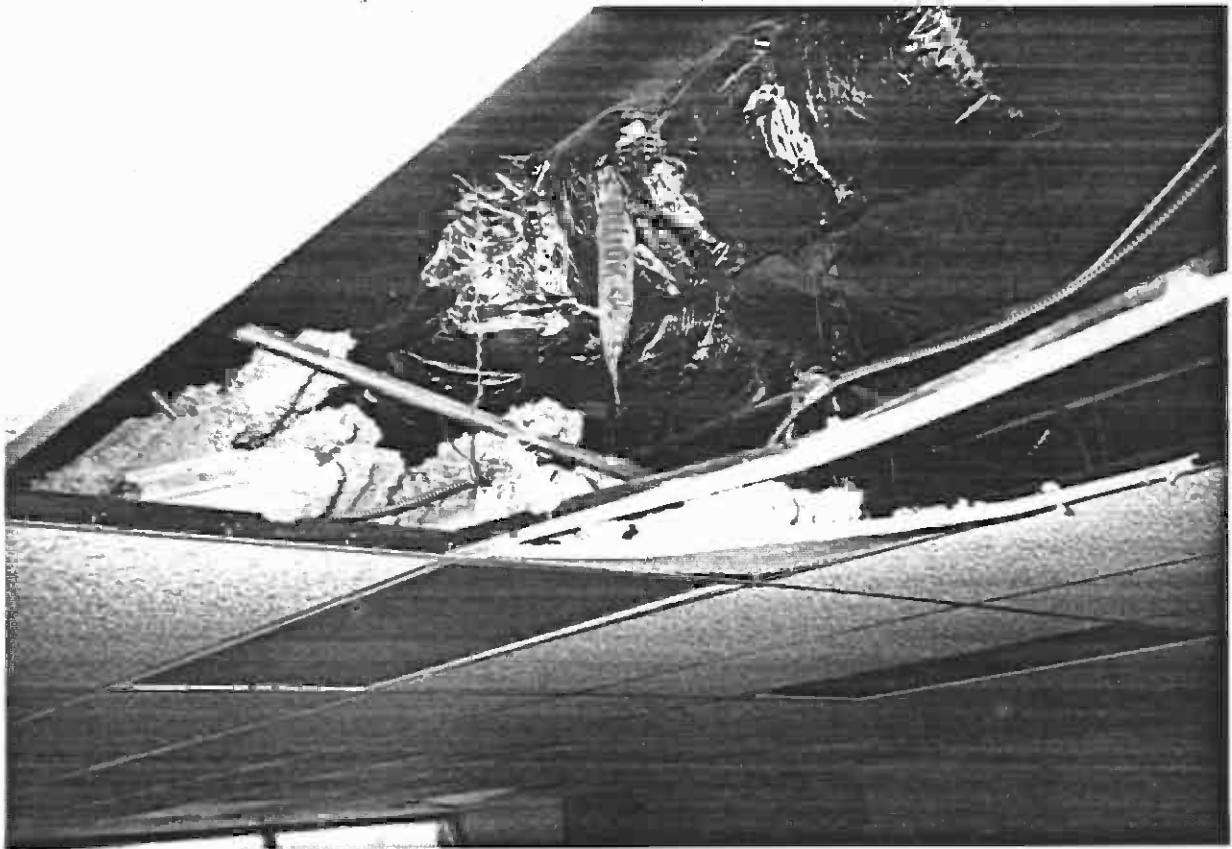
14



RM. 249-- EXPOSED ROOF DECK W/ FIREPROOFING MISSING.

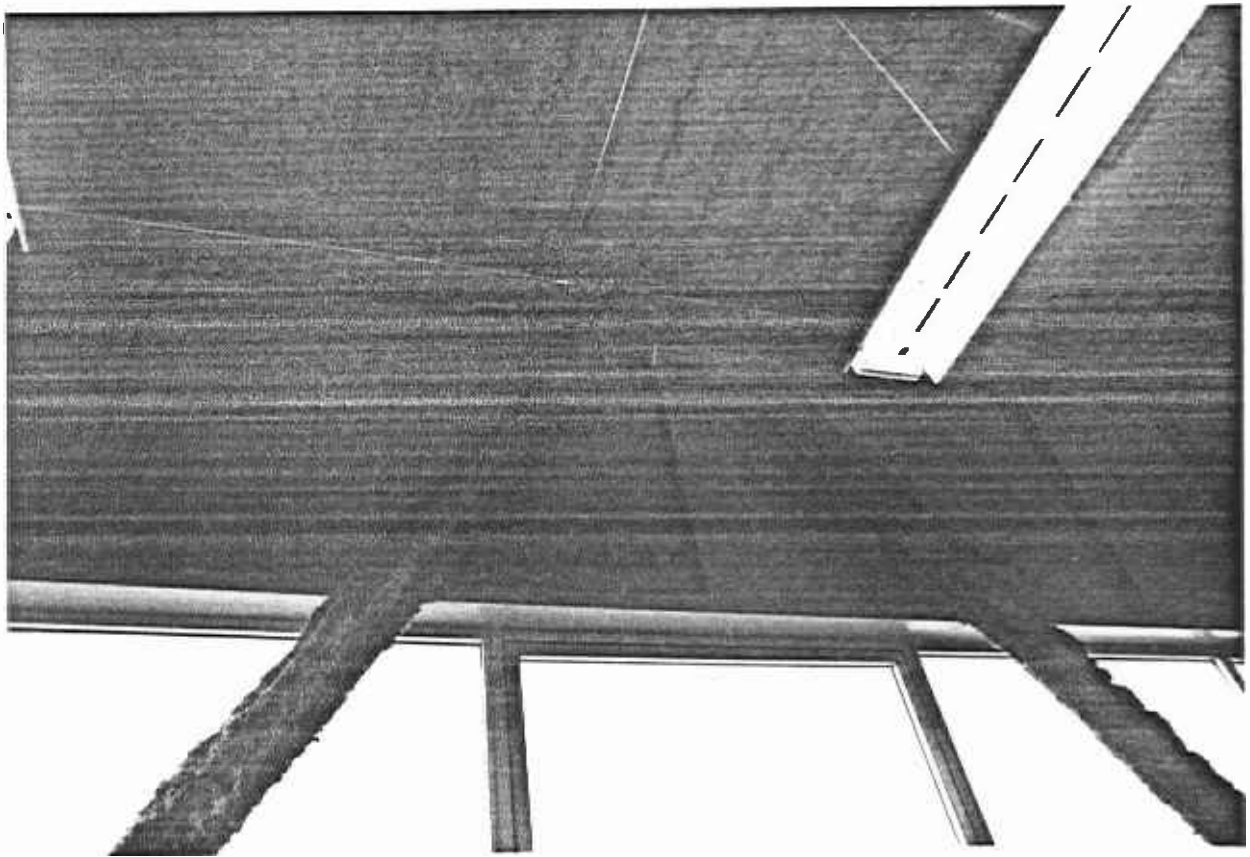


RM. 401- DECK W/ FIREPROOFING MISSING ABOVE SUSPENDED CEILING.



RM. 401- SUSPENDED ACOUSTICAL CEILING DAMAGE





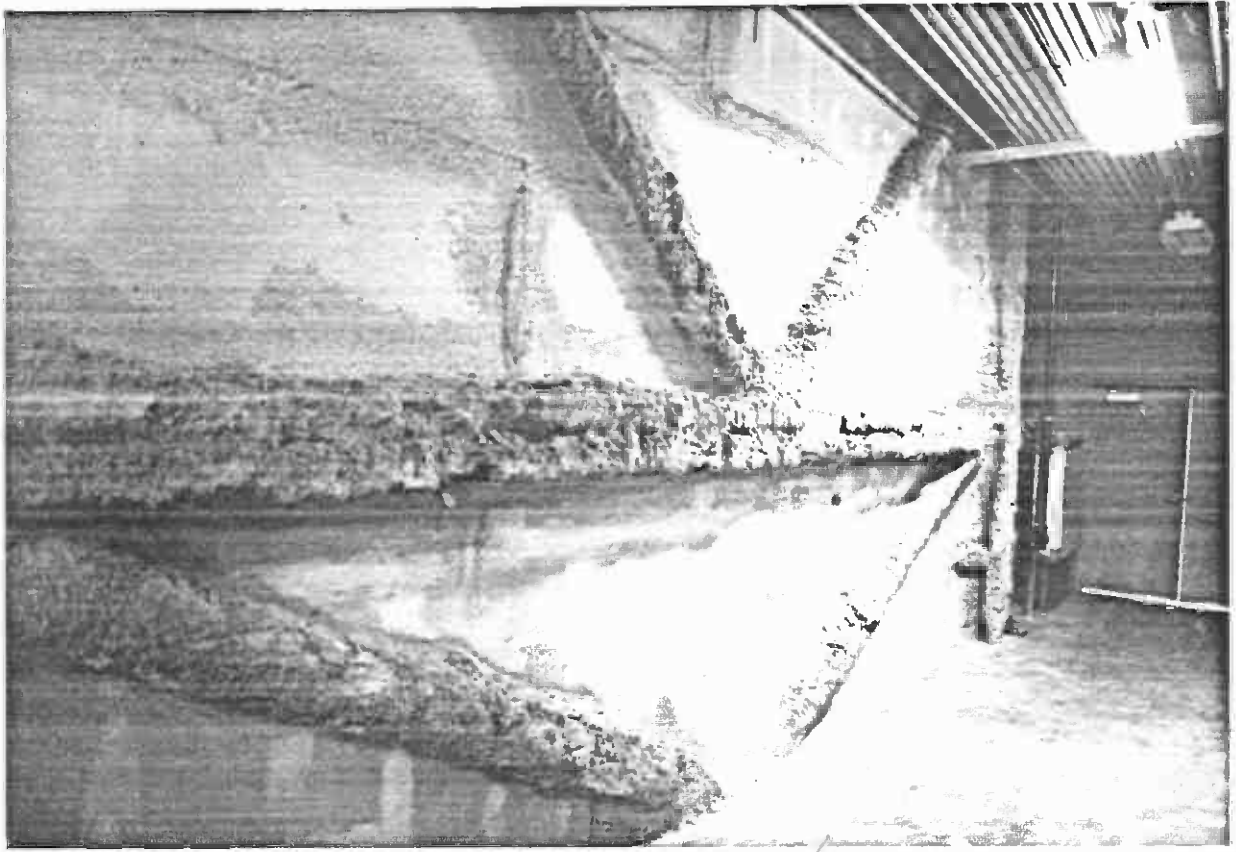
RM 104- K-BRACING BETWEEN COLS. G-6 & G-7.



RM. 104- COLUMN G-7 W/ K-BRACING



RM. 104- COLUMN F.6-6 W/ K-BRACING



RM 276- K-BRACING AT COL D-13.

21

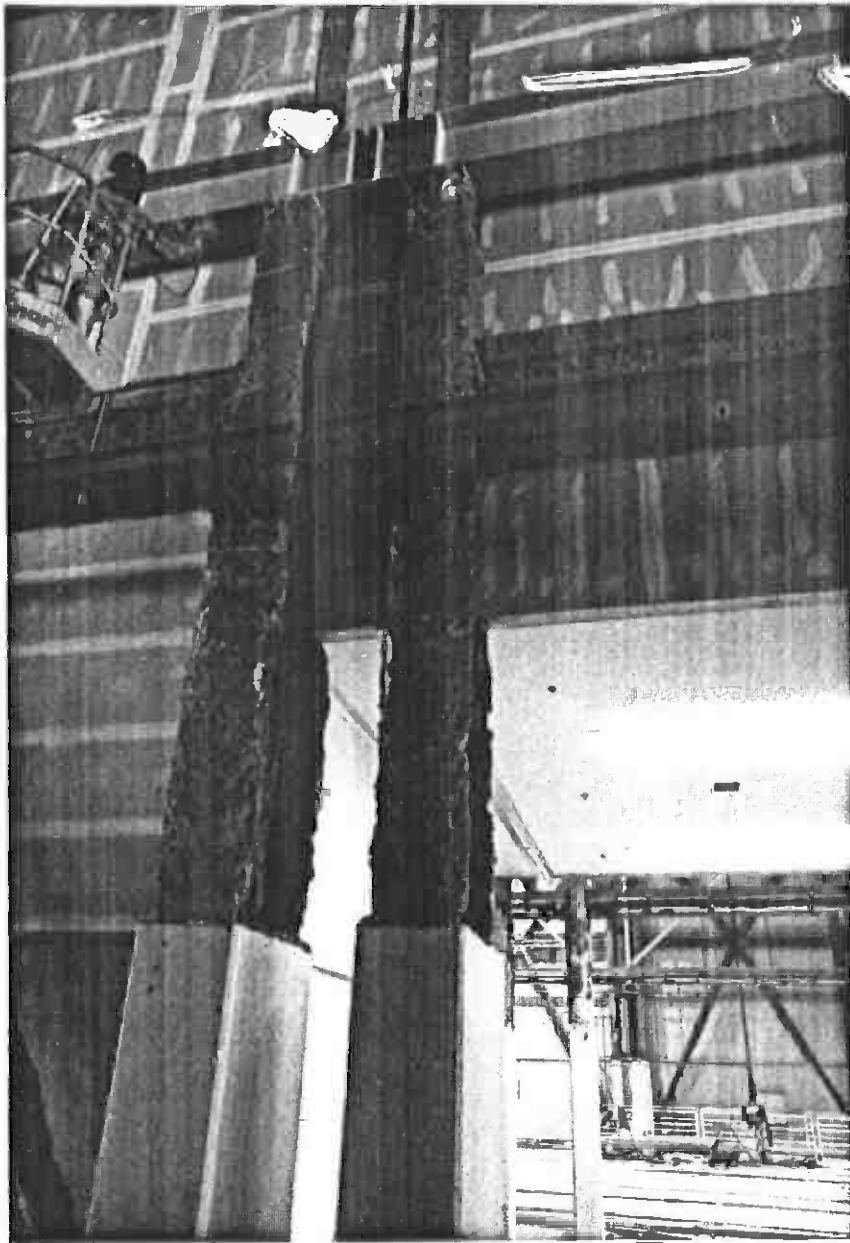


RM 276- WEST WALL

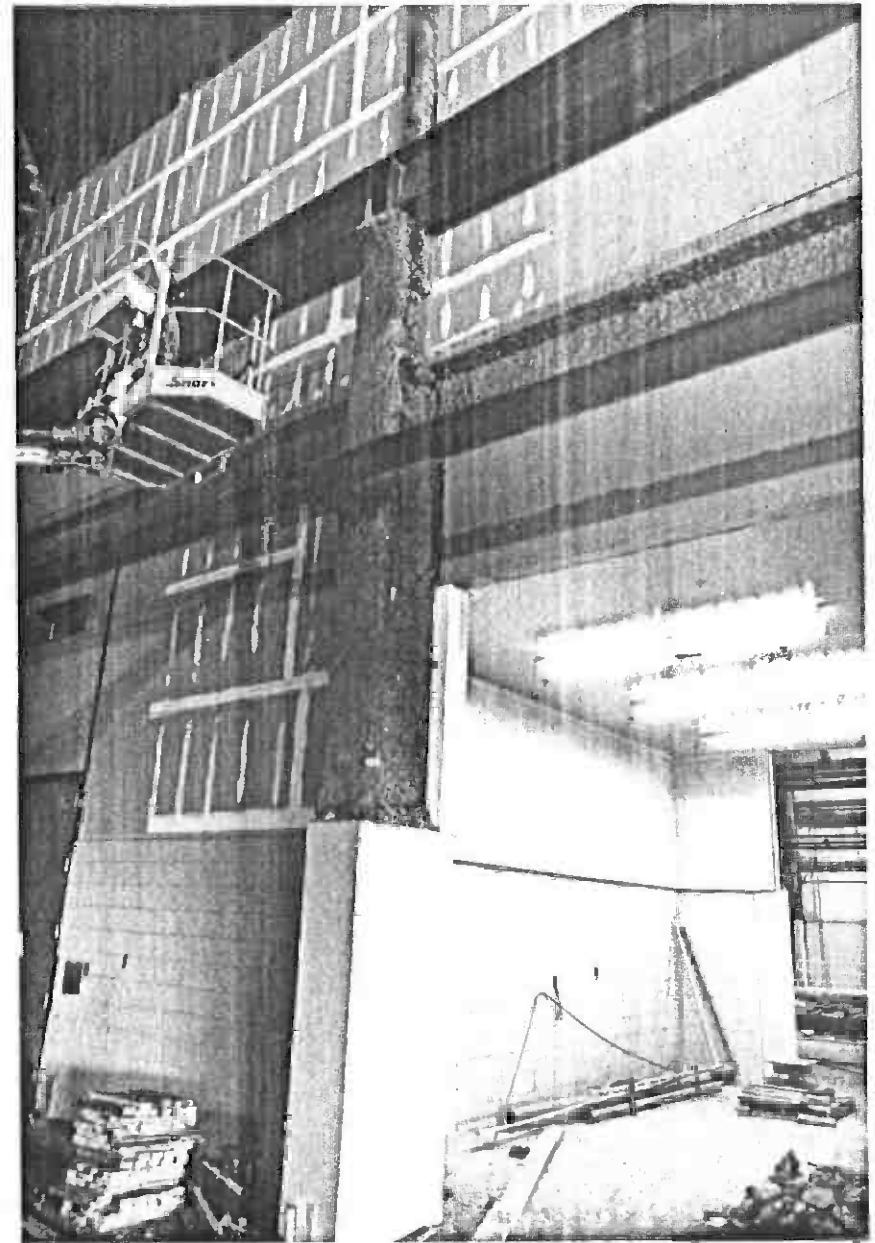
22



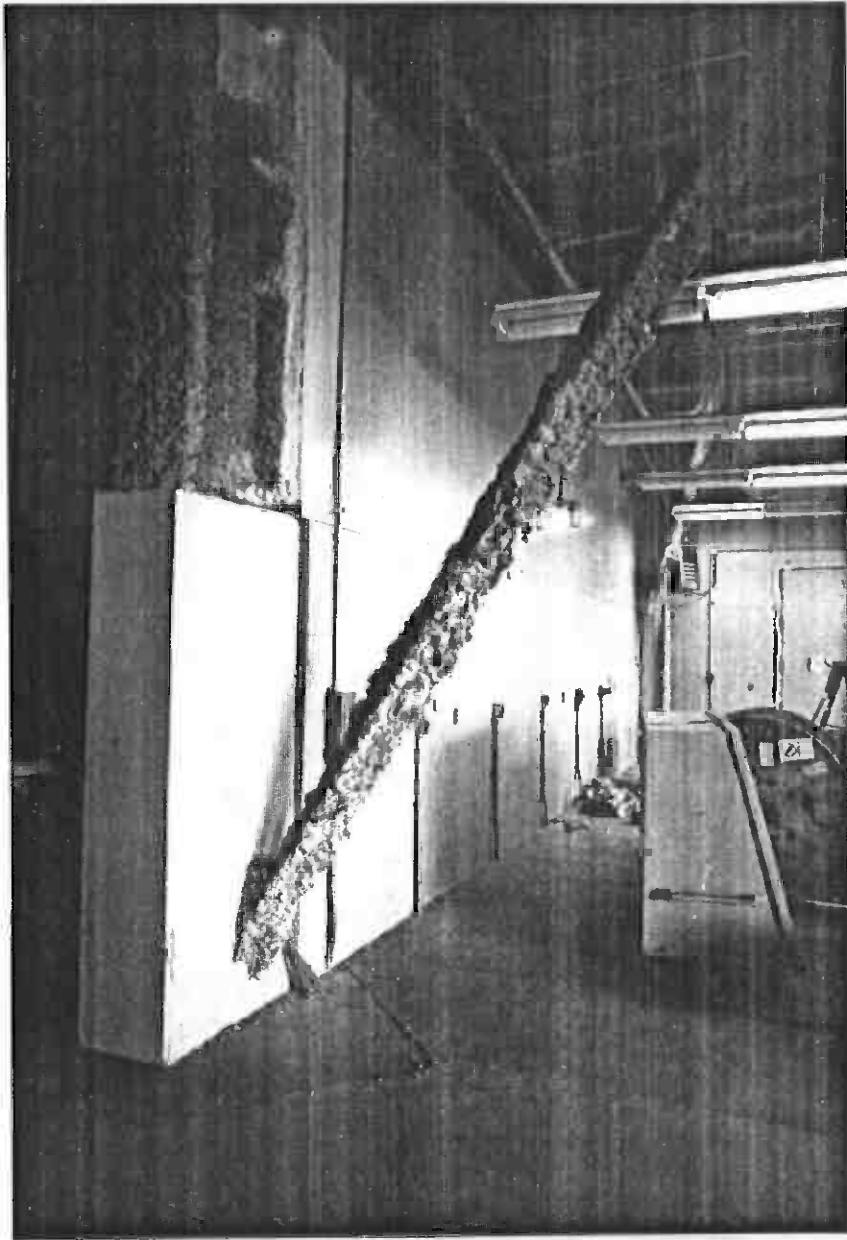
RM. 278- EXPOSED ROOF DECK



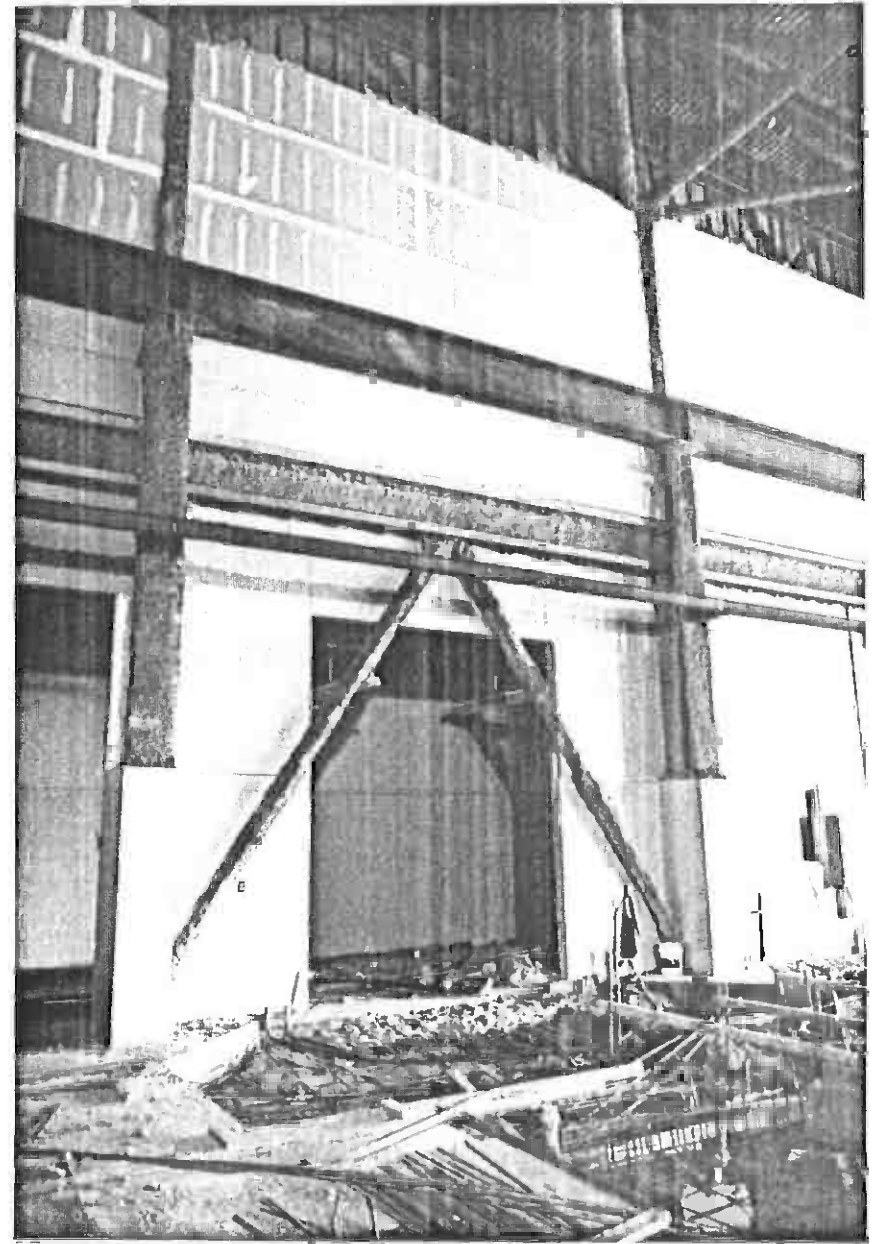
RM. 124- COLS. D-11.9 & D-12.1.



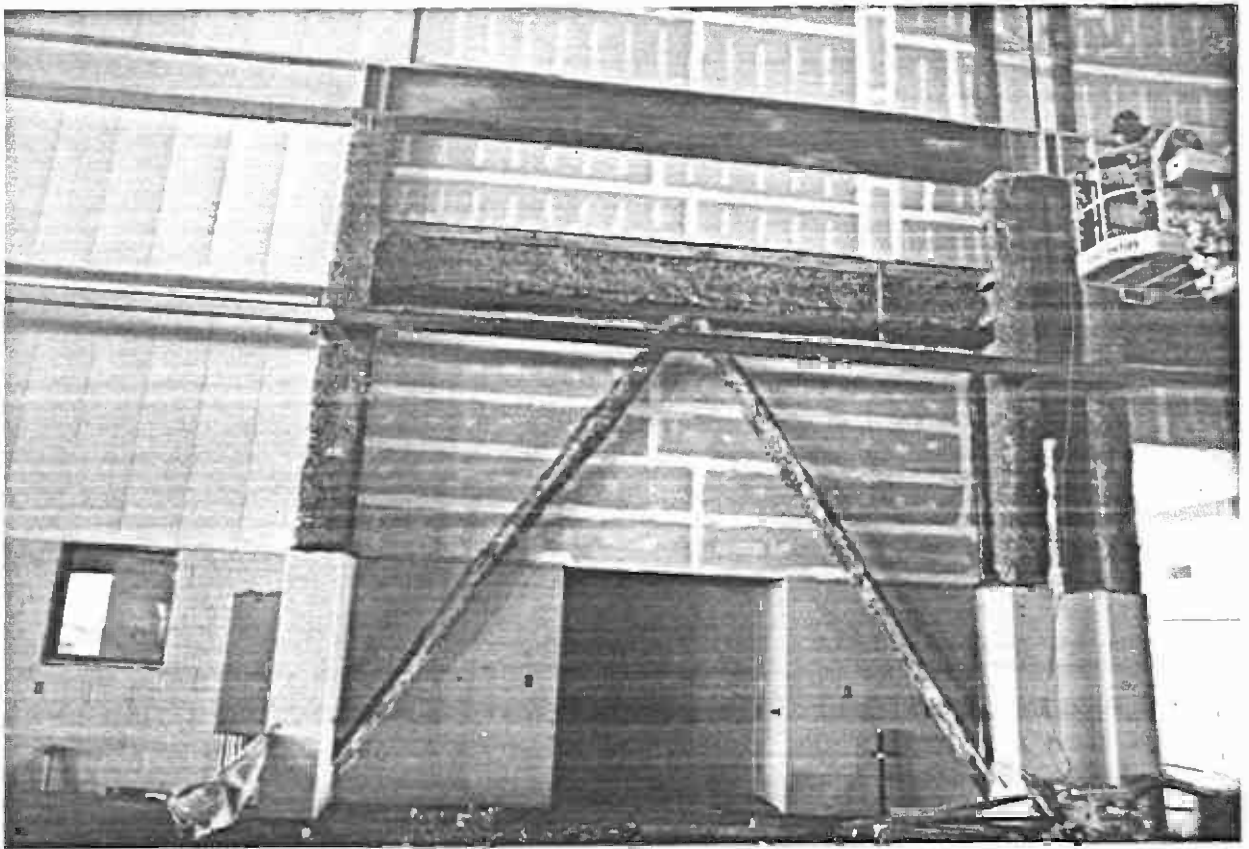
RM. 124- COLUMN D-15.



RM. 124- COL F-7 W/ K-BRACING

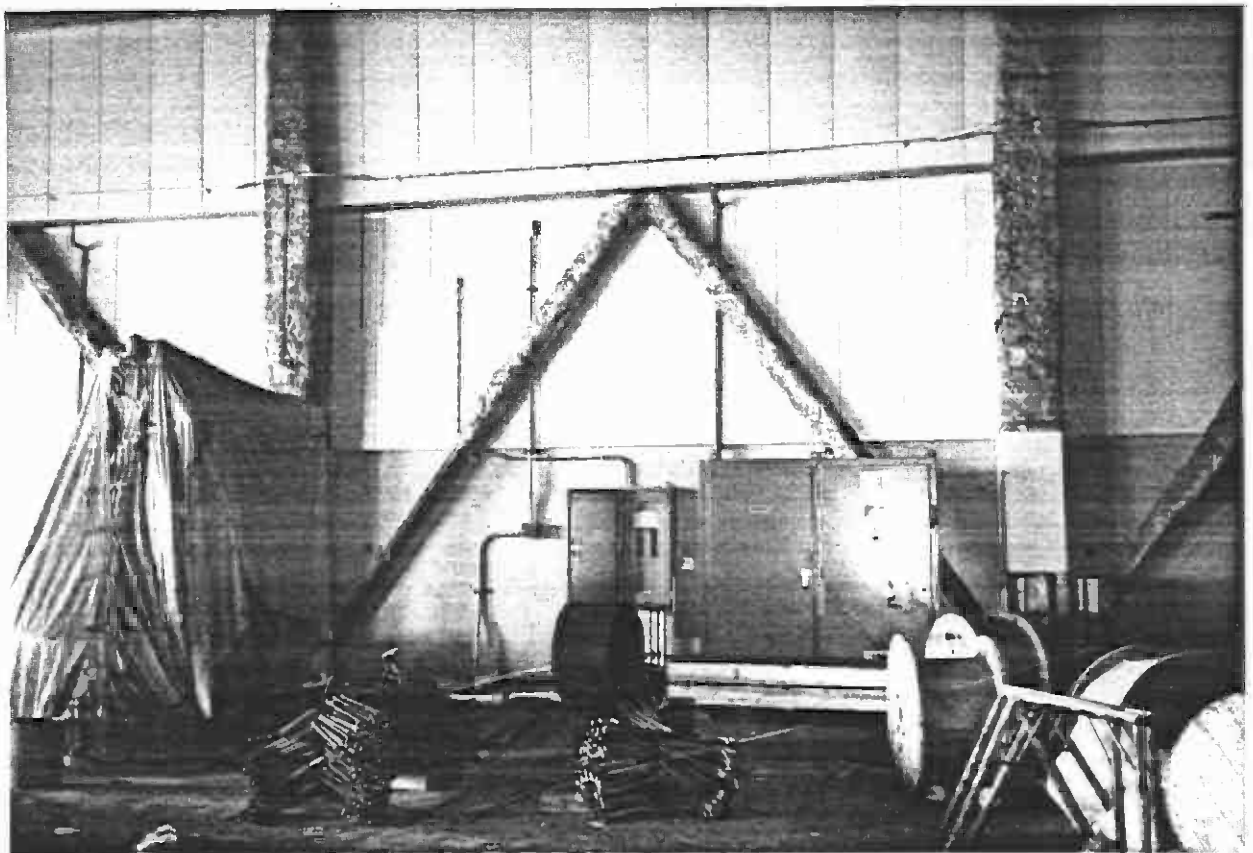


RM. 124- COLS. D-16 & D-17 W/ K-BRACING



RM. 124- COLS. D-11, D-11.9 & D-121 W/ K-BRACING

28

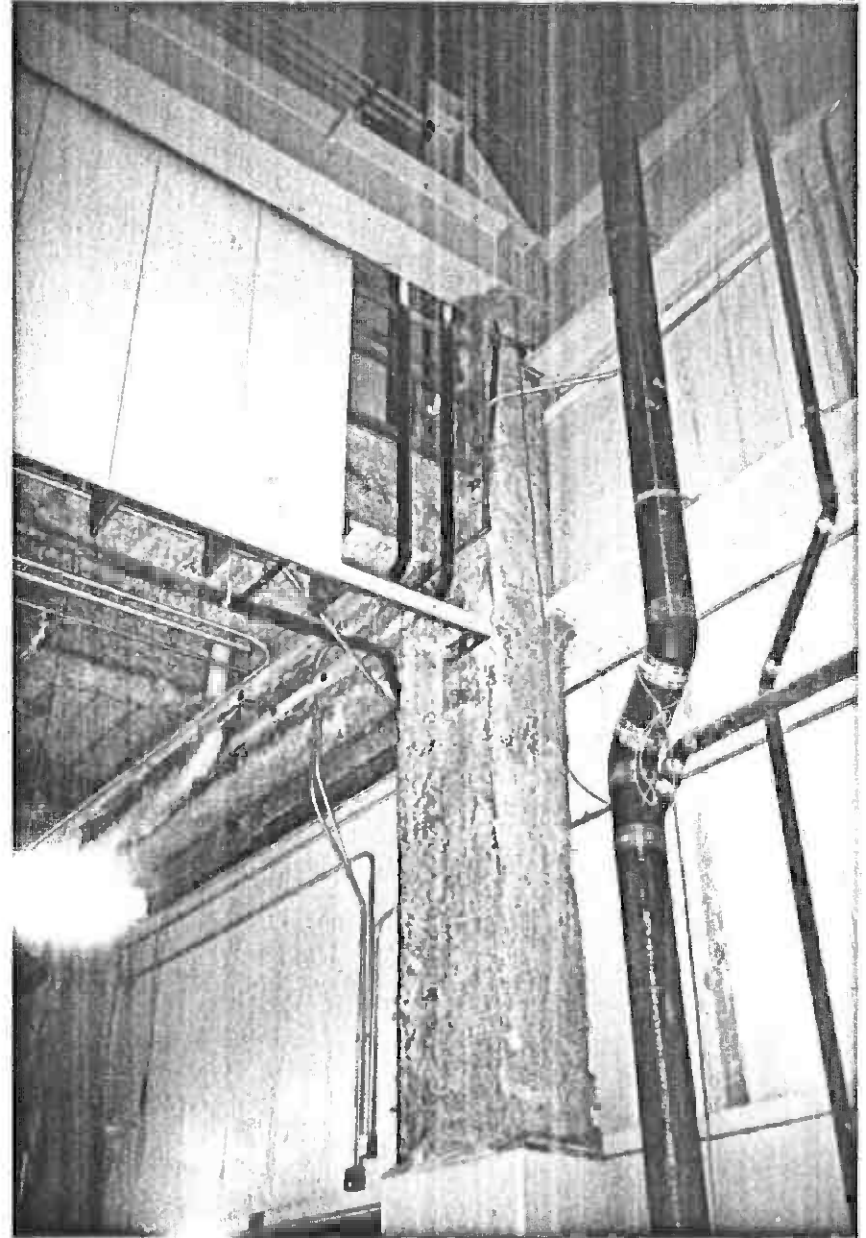


RM. 124- COLS. F-17 & F-18 W/ K-BRACING

29

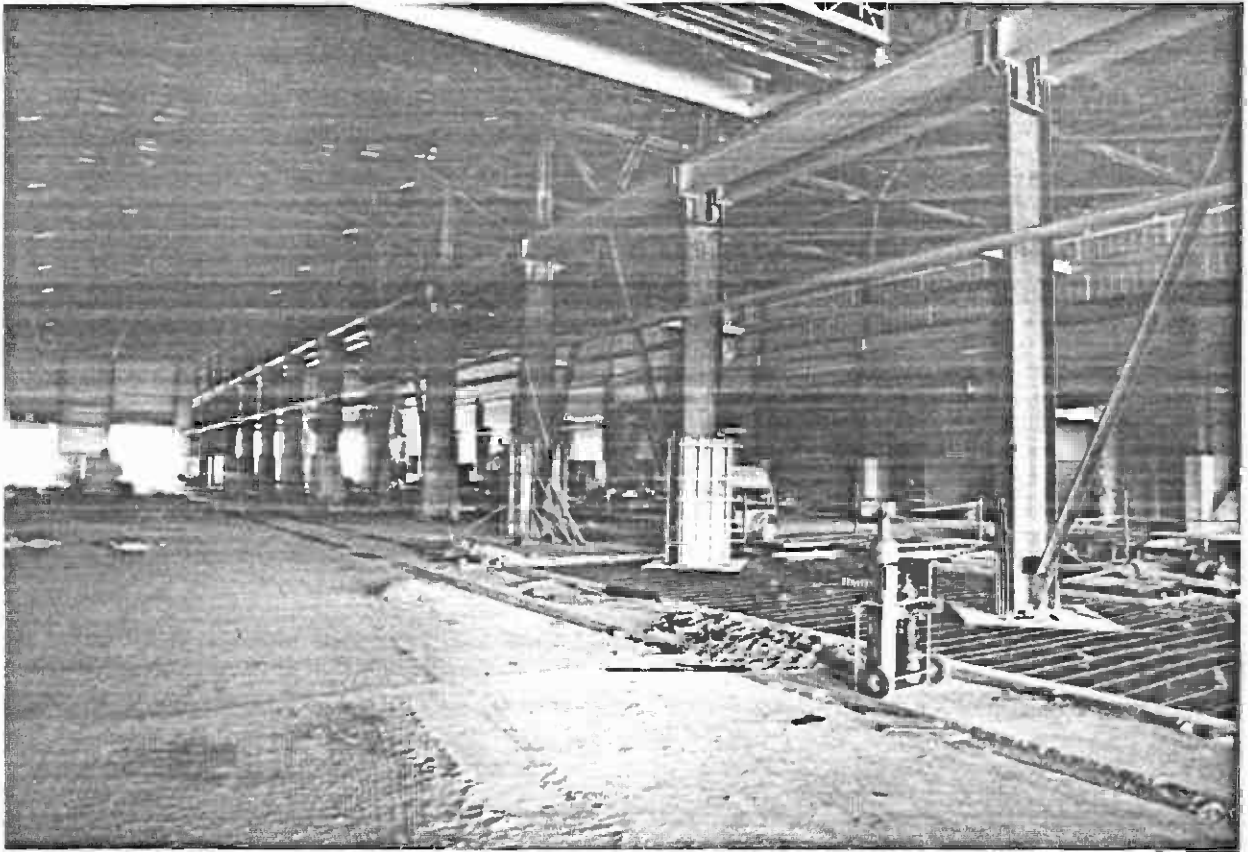


RM. 124- COL F-6 W/ TYP. SURF. MNTD. LT.



RM. 124- COL F-5.

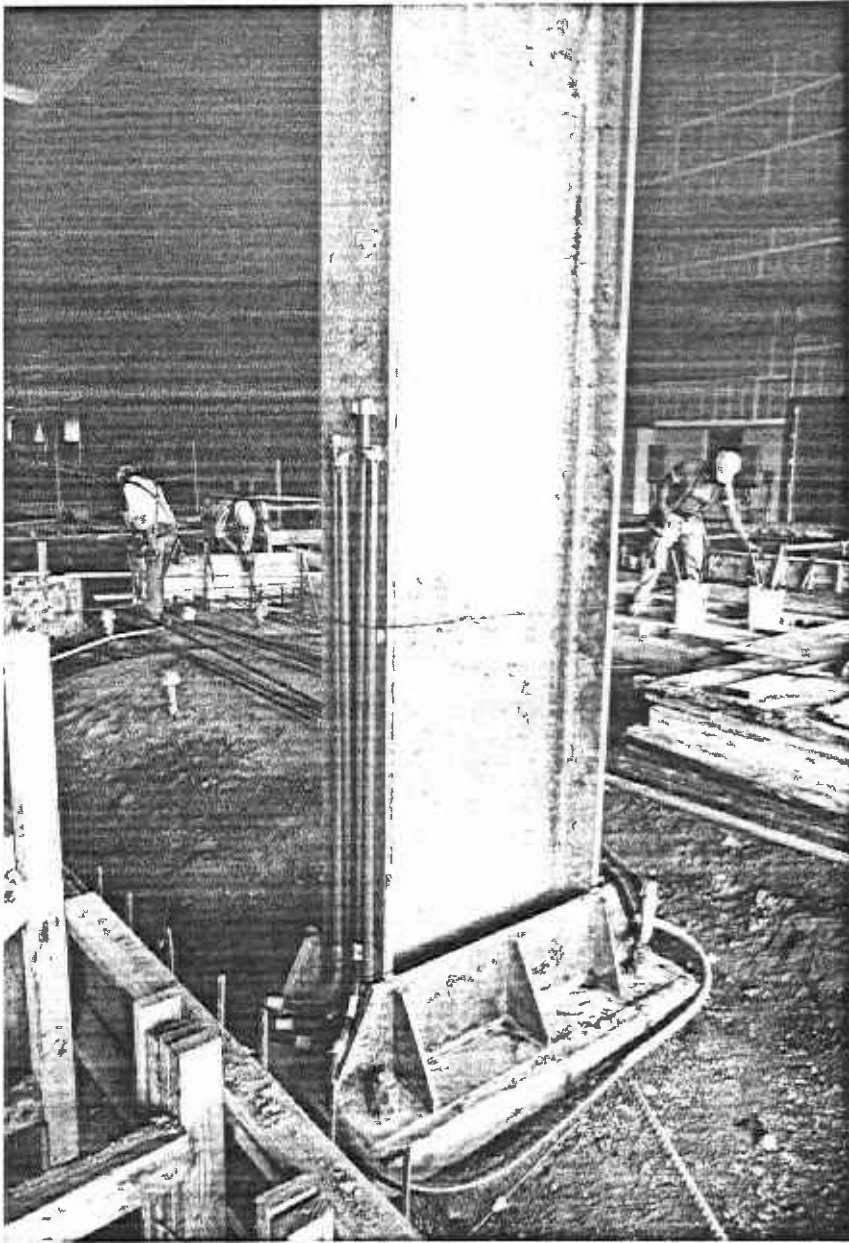




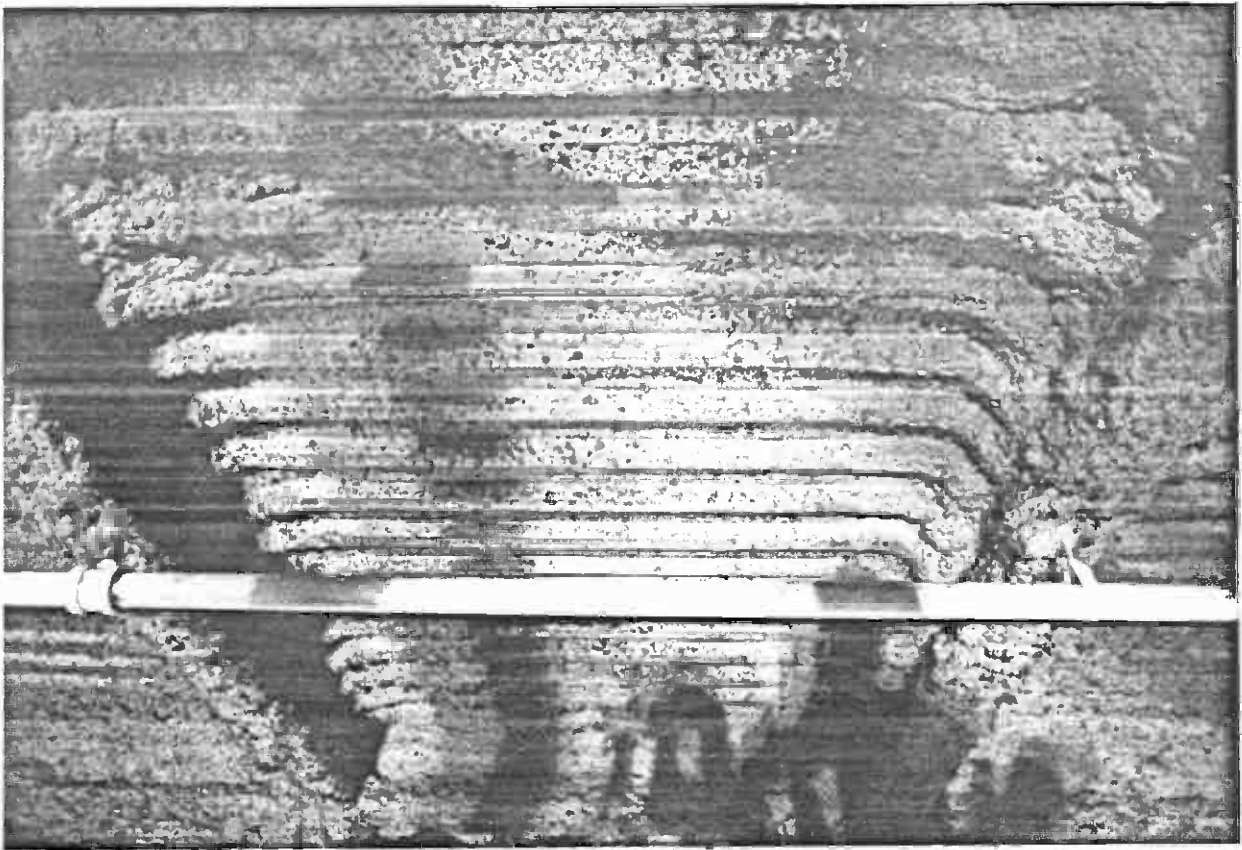
RM. 124- COLUMNS AT GRIDLINE E



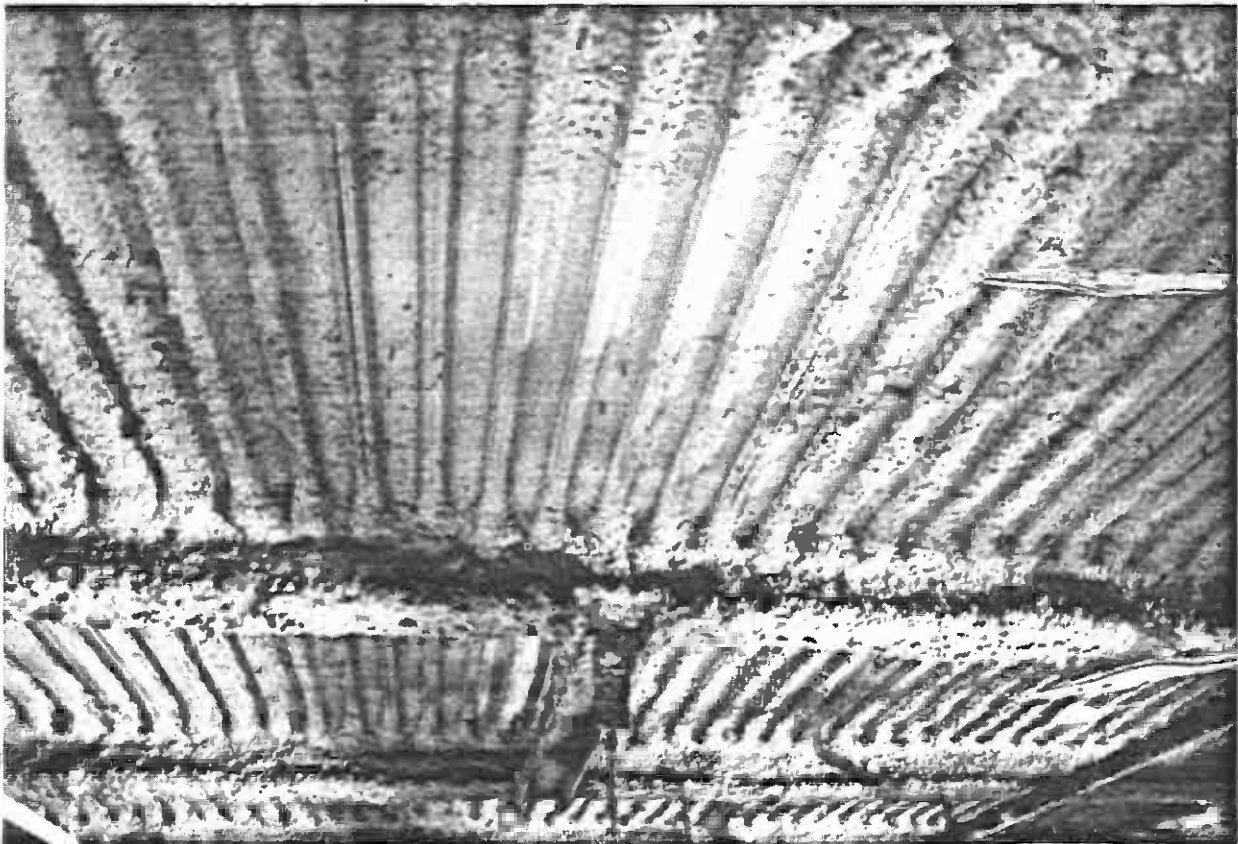
RM. 124- COLUMN E-17.



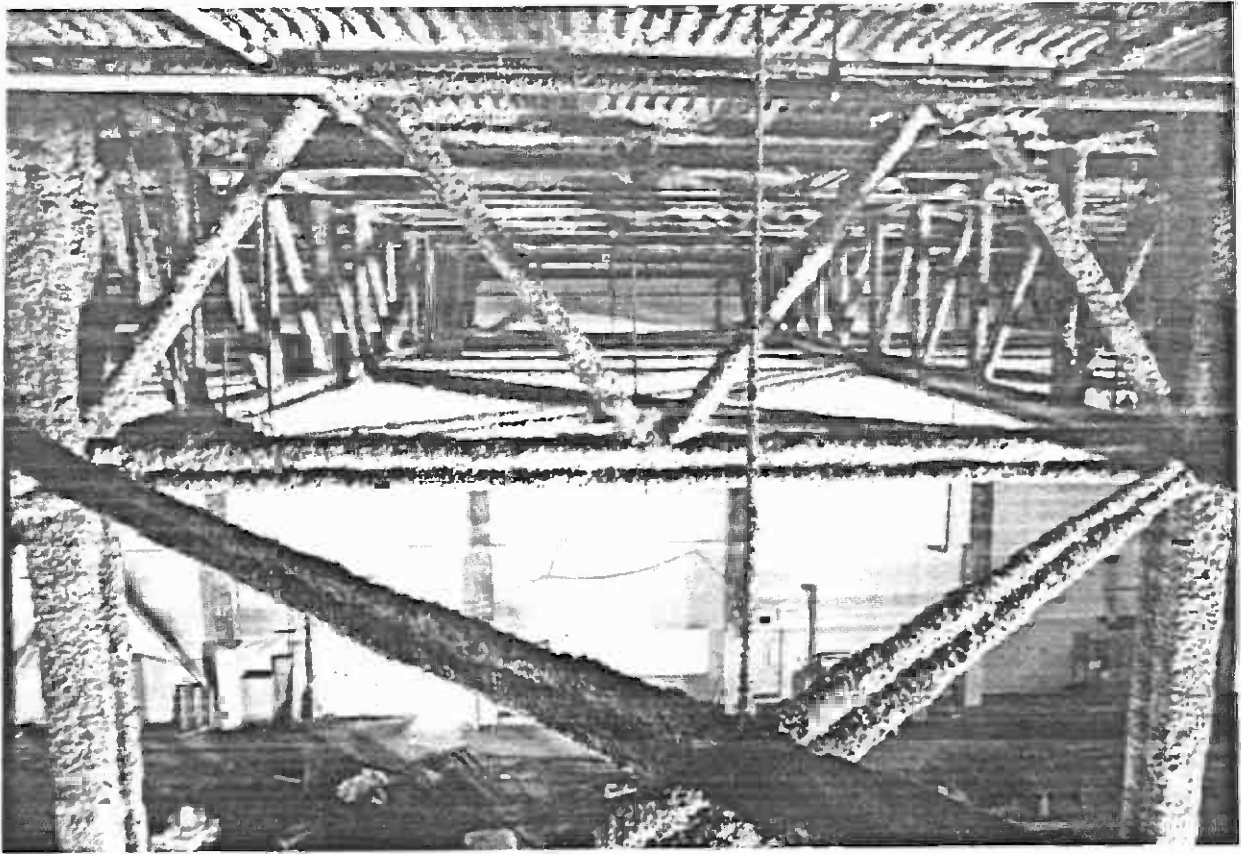
RM 124- COLUMN E-19.



RM. 124- EXPOSED ROOF DECK

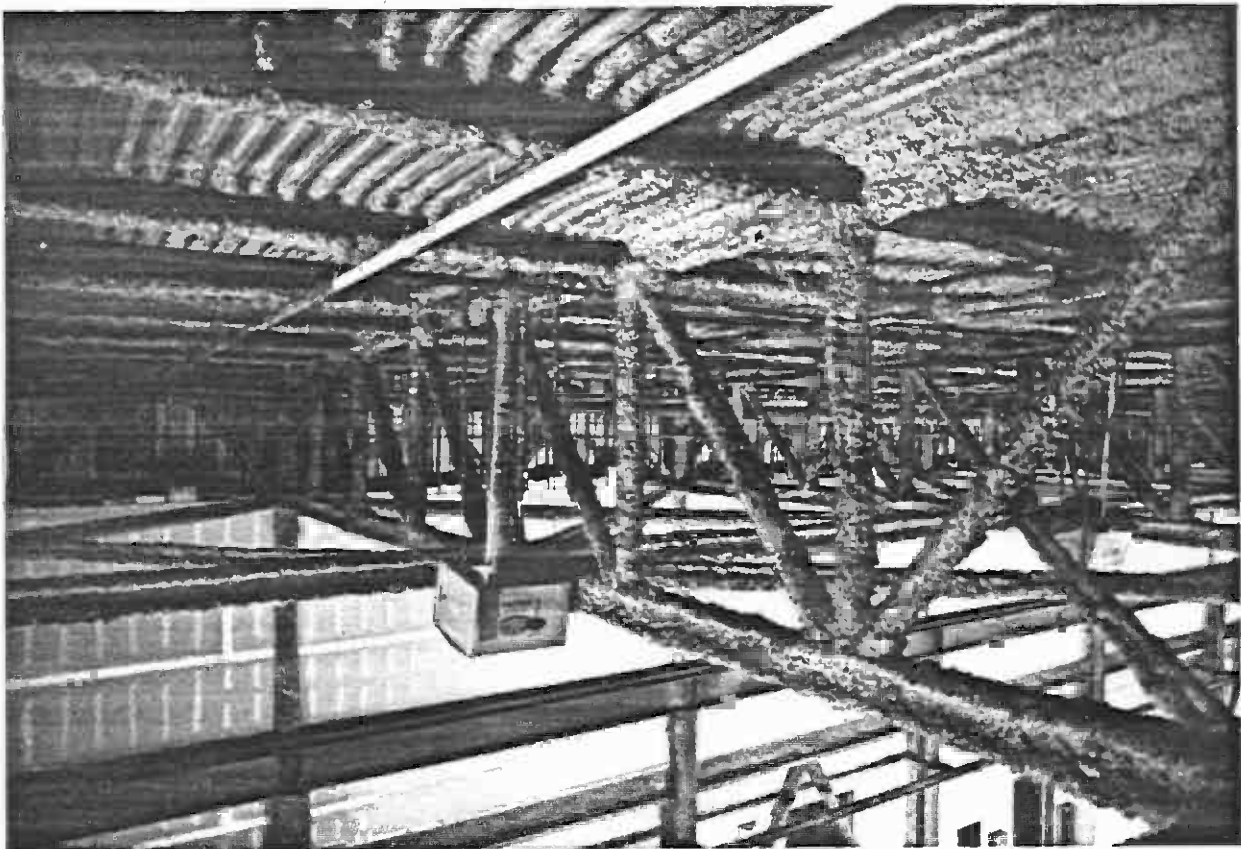


RM. 124- EXPOSED ROOF DECK



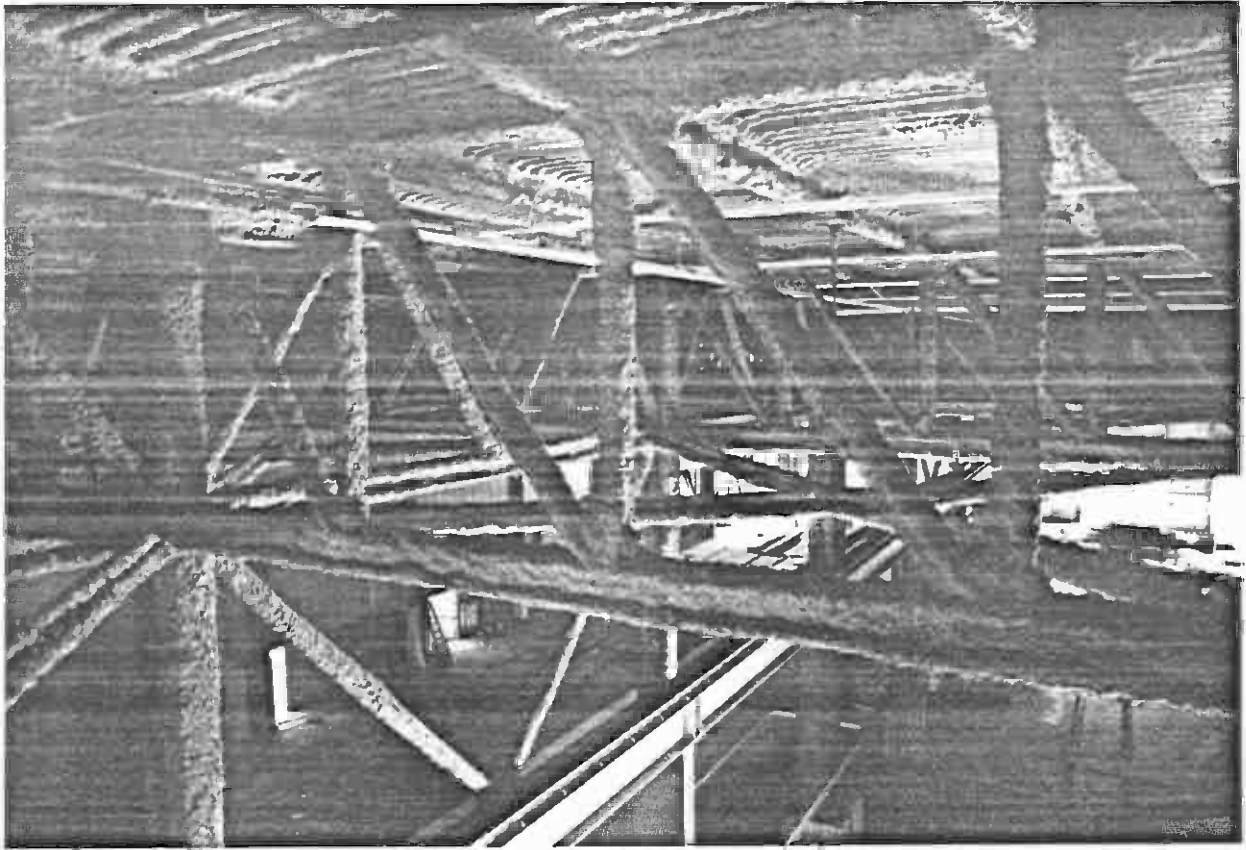
RM. 124- ROOF TRUSSES.

37



RM. 124- ROOF TRUSSES.

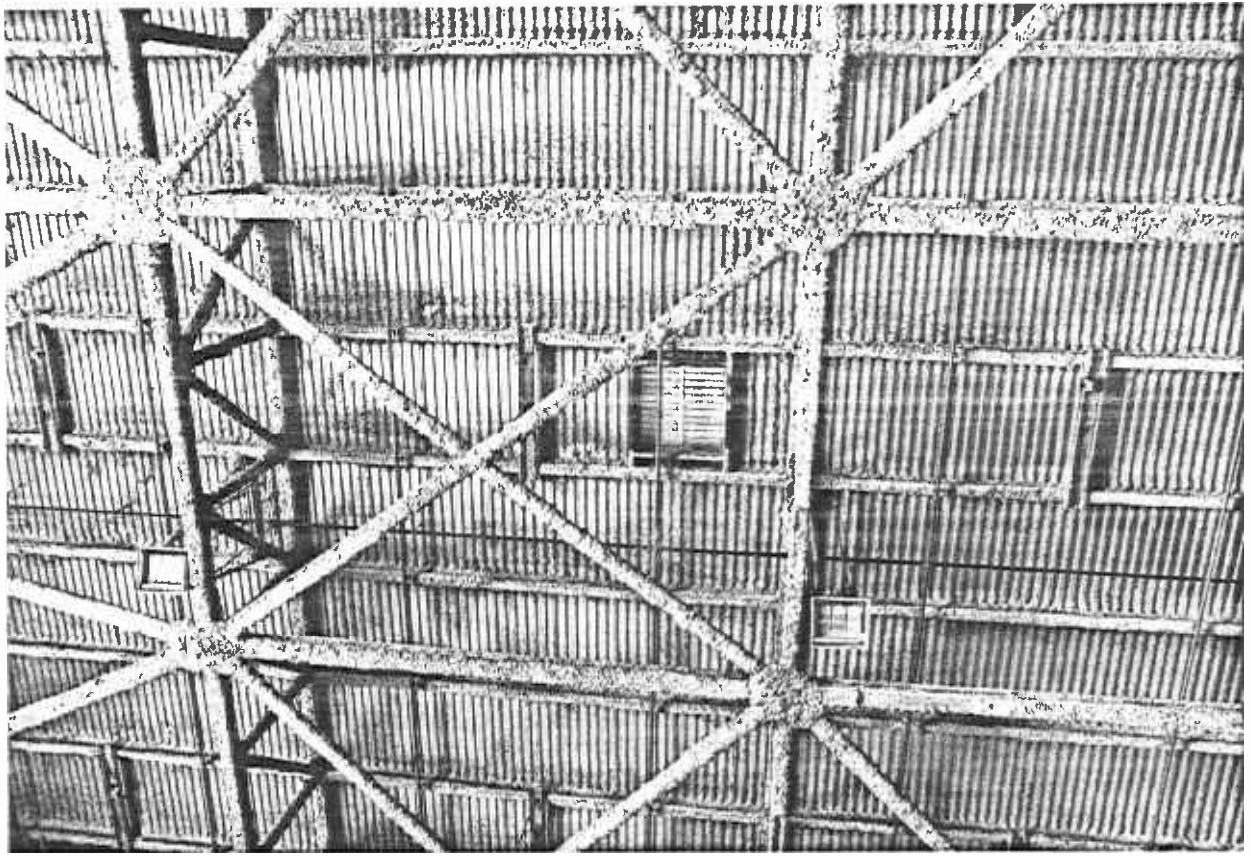
38



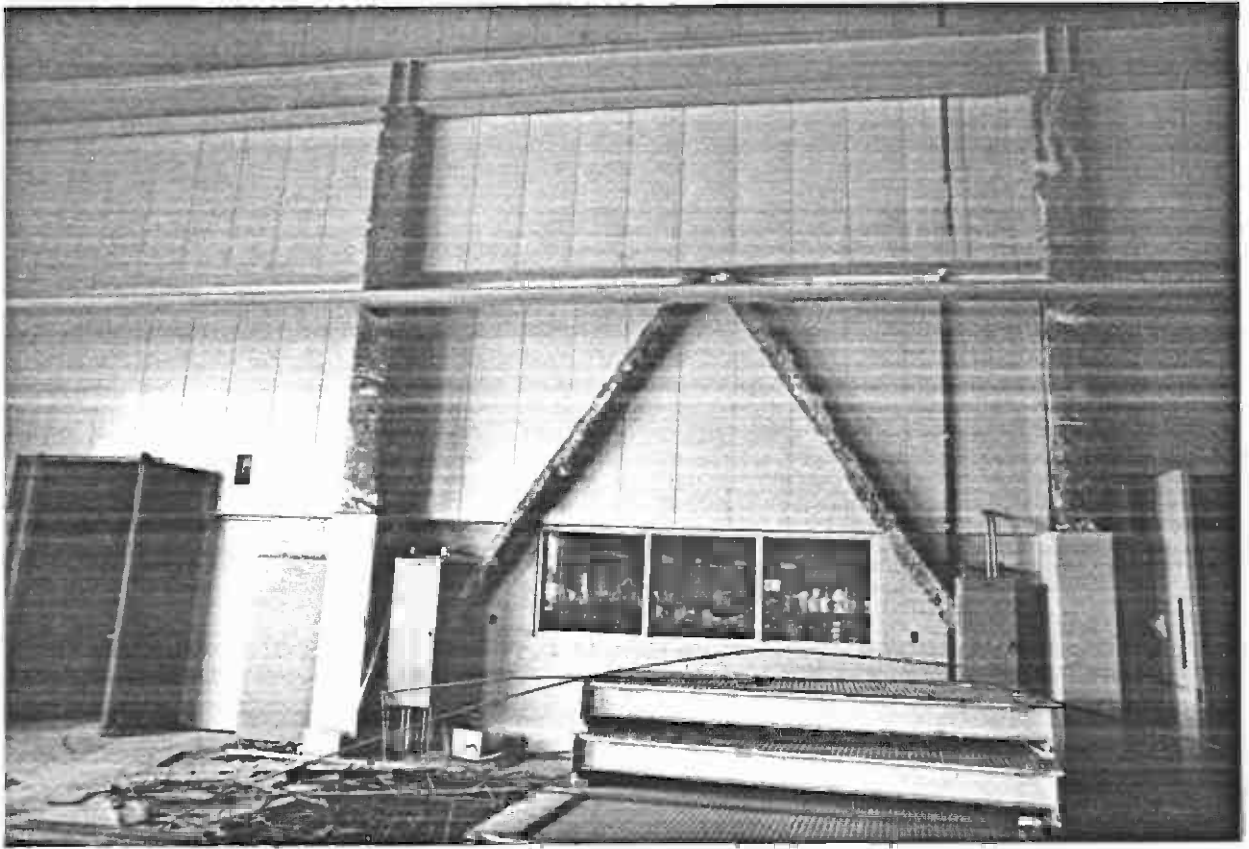
RM. 124- ROOF TRUSSES.



RM. 124- ROOF TRUSSES, BOT. CHORD BRACING & PURLINS.



RM 124- ROOF TRUSSES, BOT. CHORD BRACING & PURLINS.



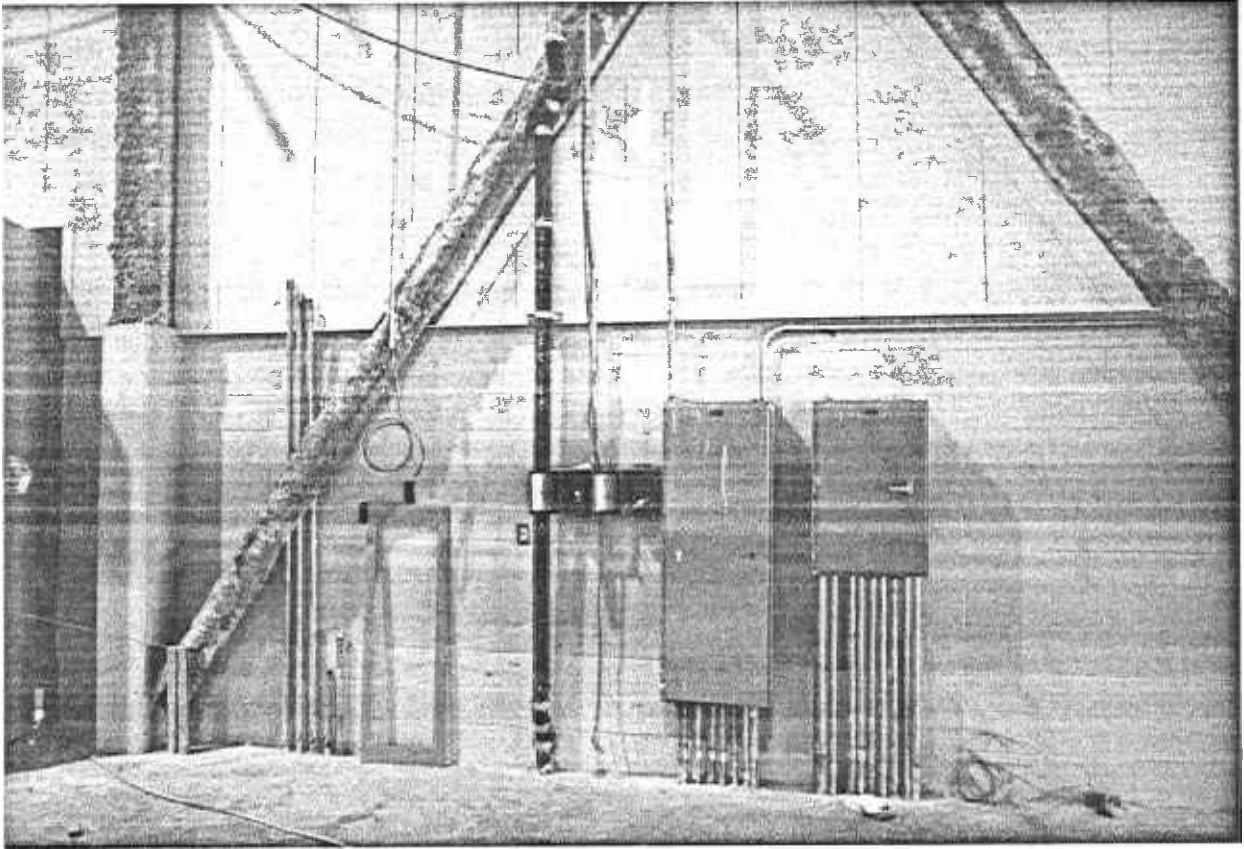
RM. 124- COLS. & K-BRACING AT GRIDLINE D-6 & D-7.

42



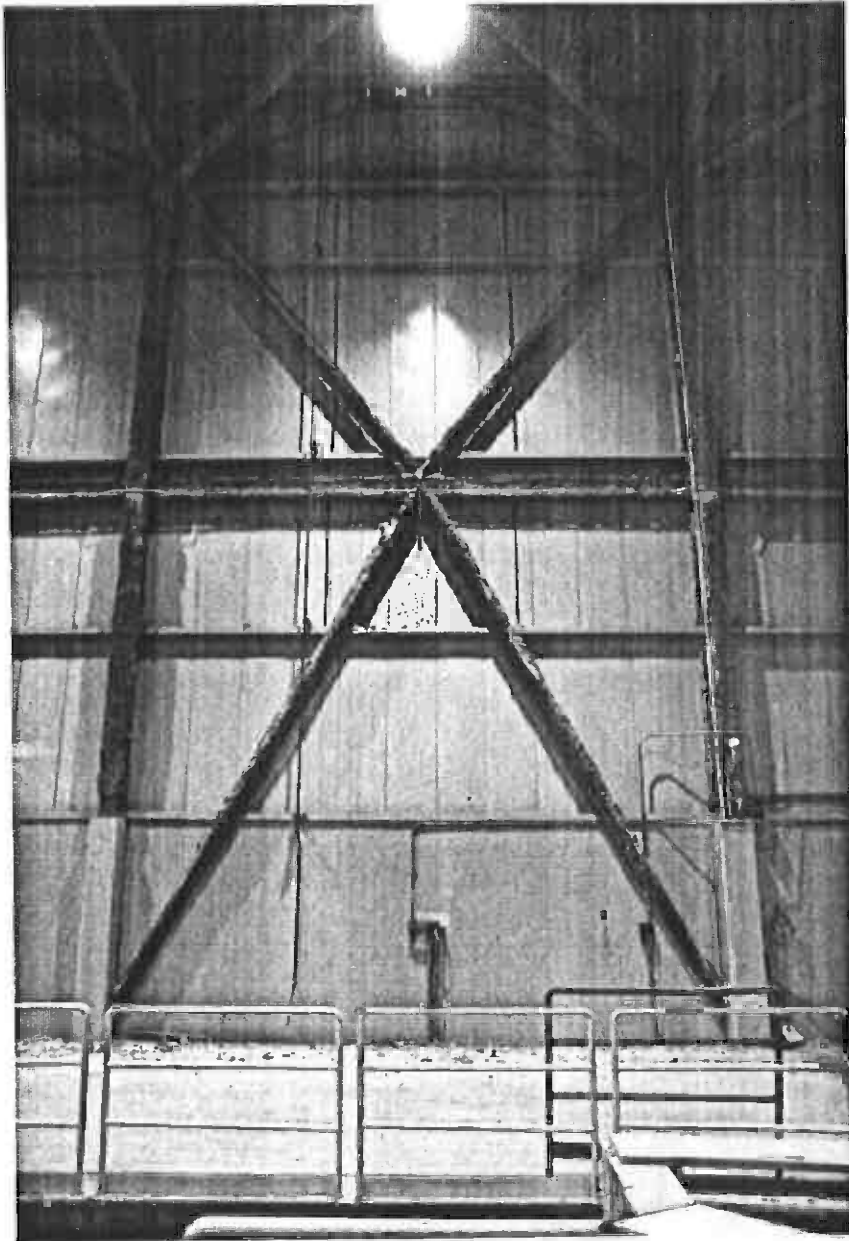
RM. 156

43

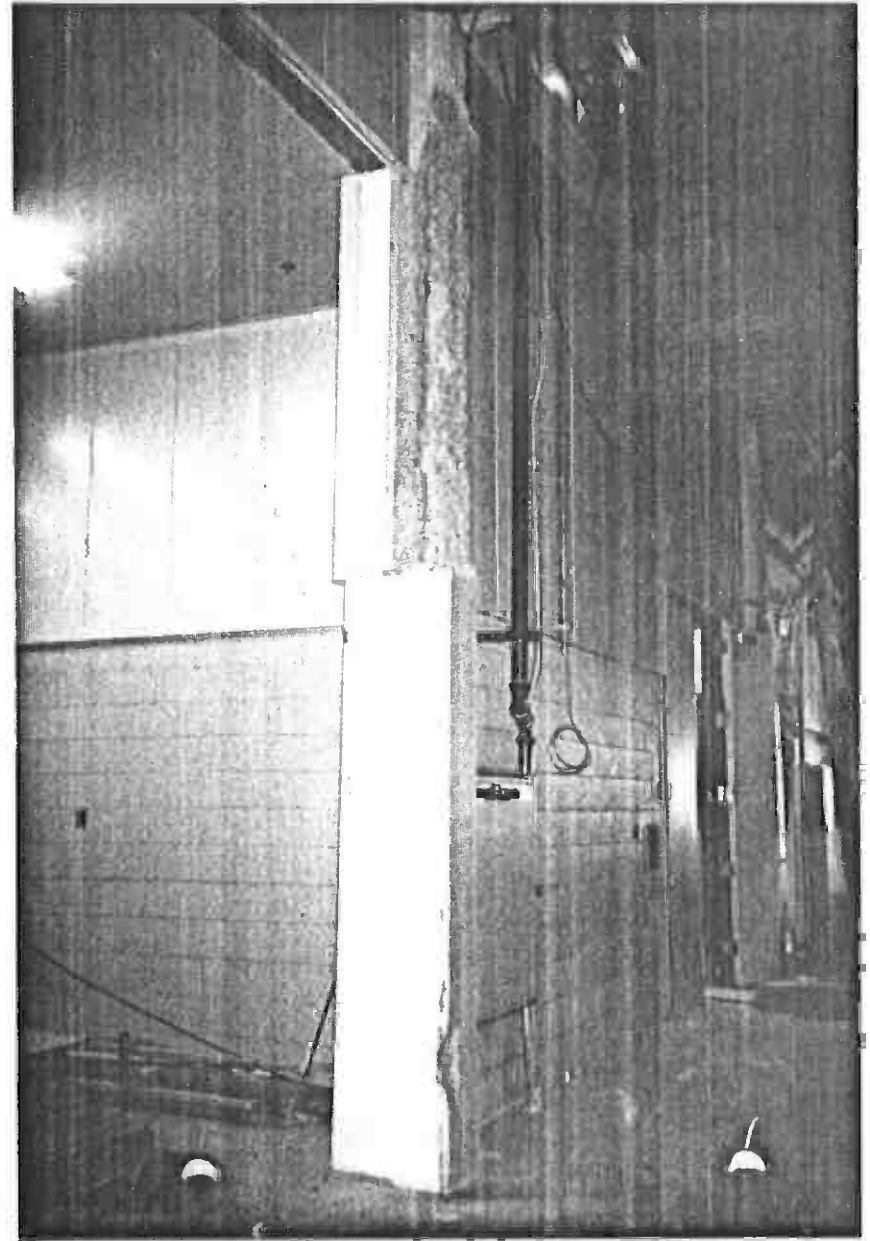


RM. 156- COL & K-BRACING AT GRIDLINE C-6 & C-7.

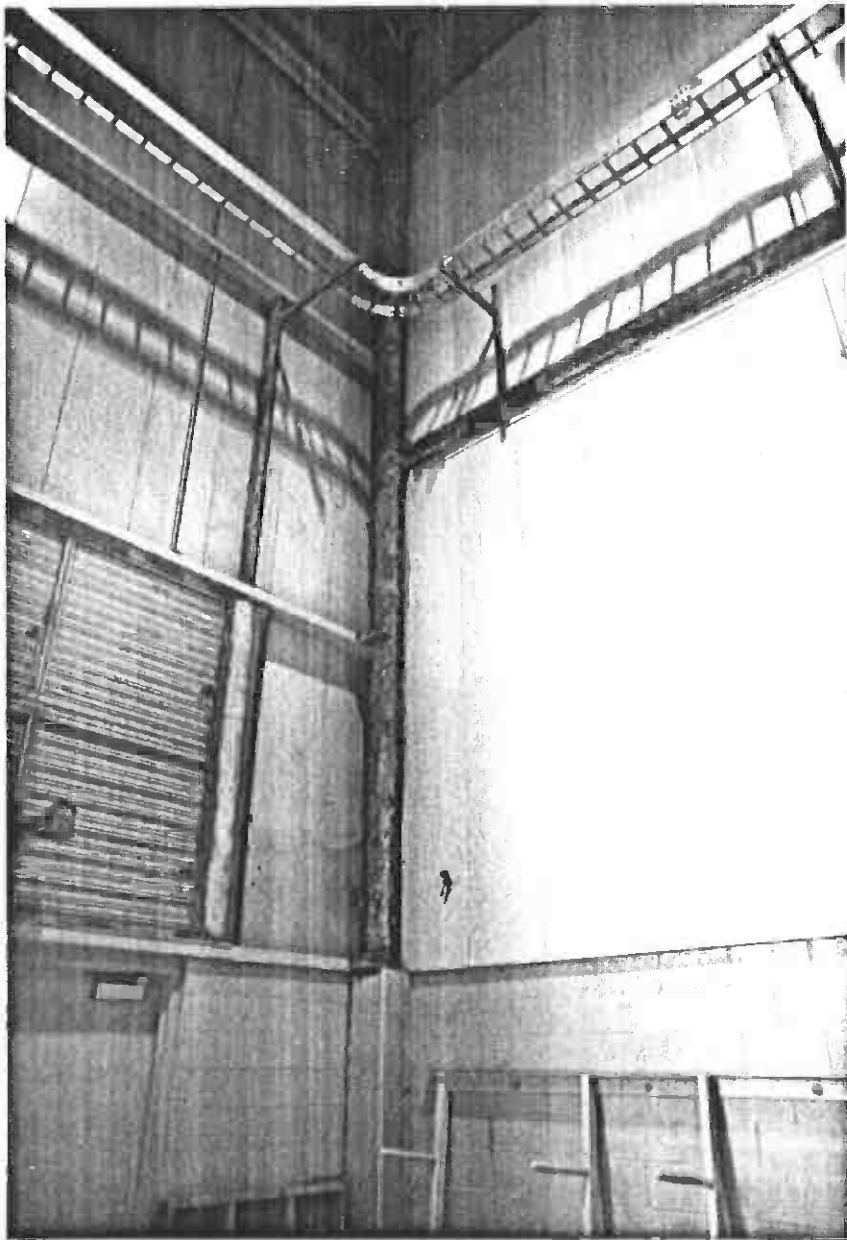




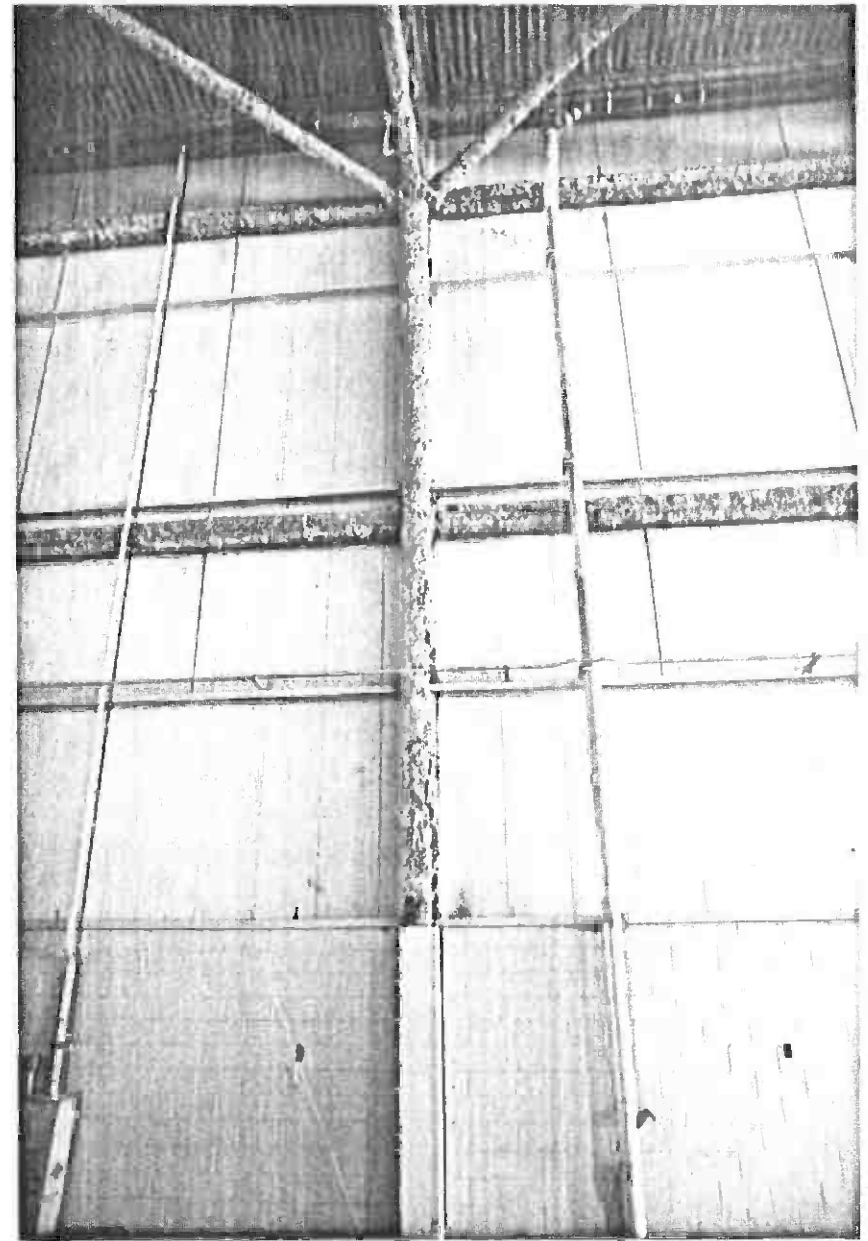
RM. 156- COL & K-BRACING B-9 & B-10.



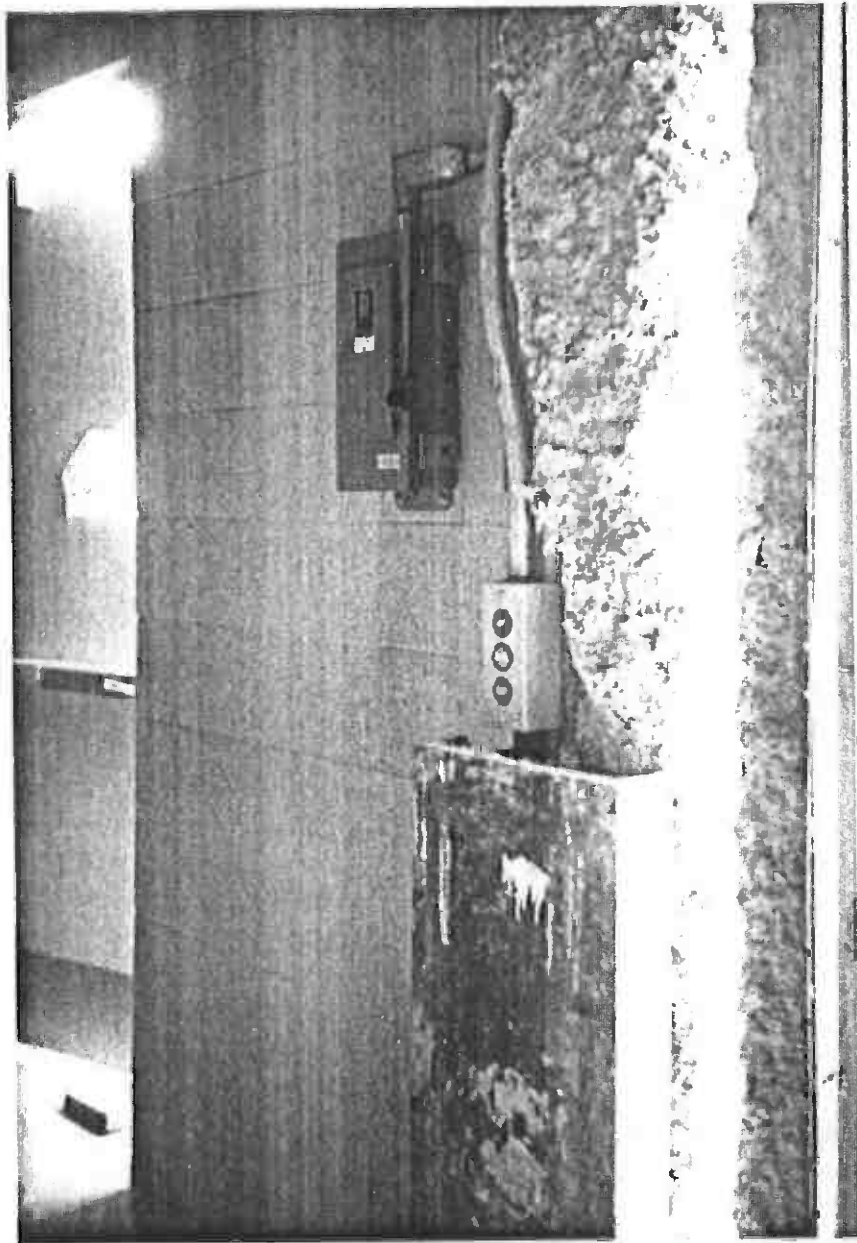
RM. 156- COLUMN C-15.



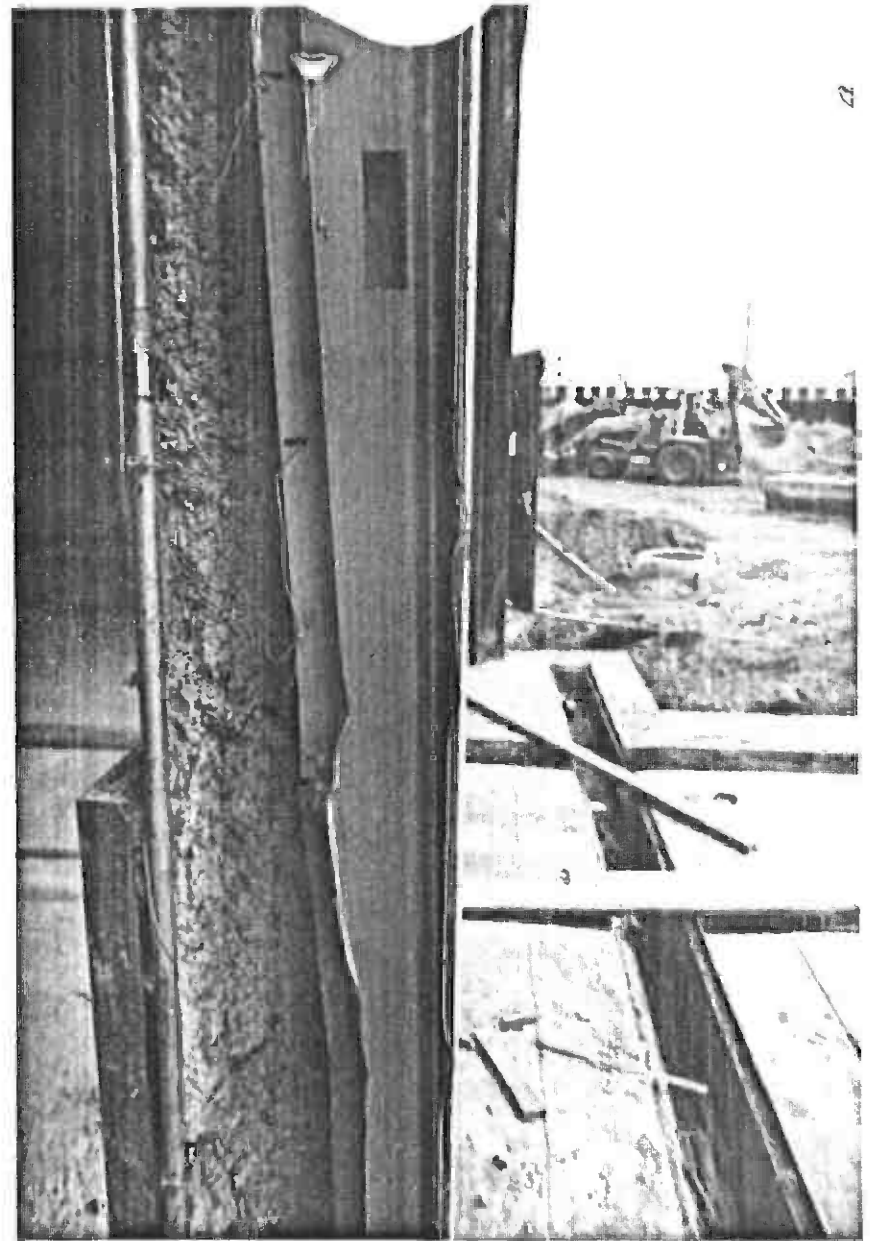
RM. 156- COLUMN B-1.1.



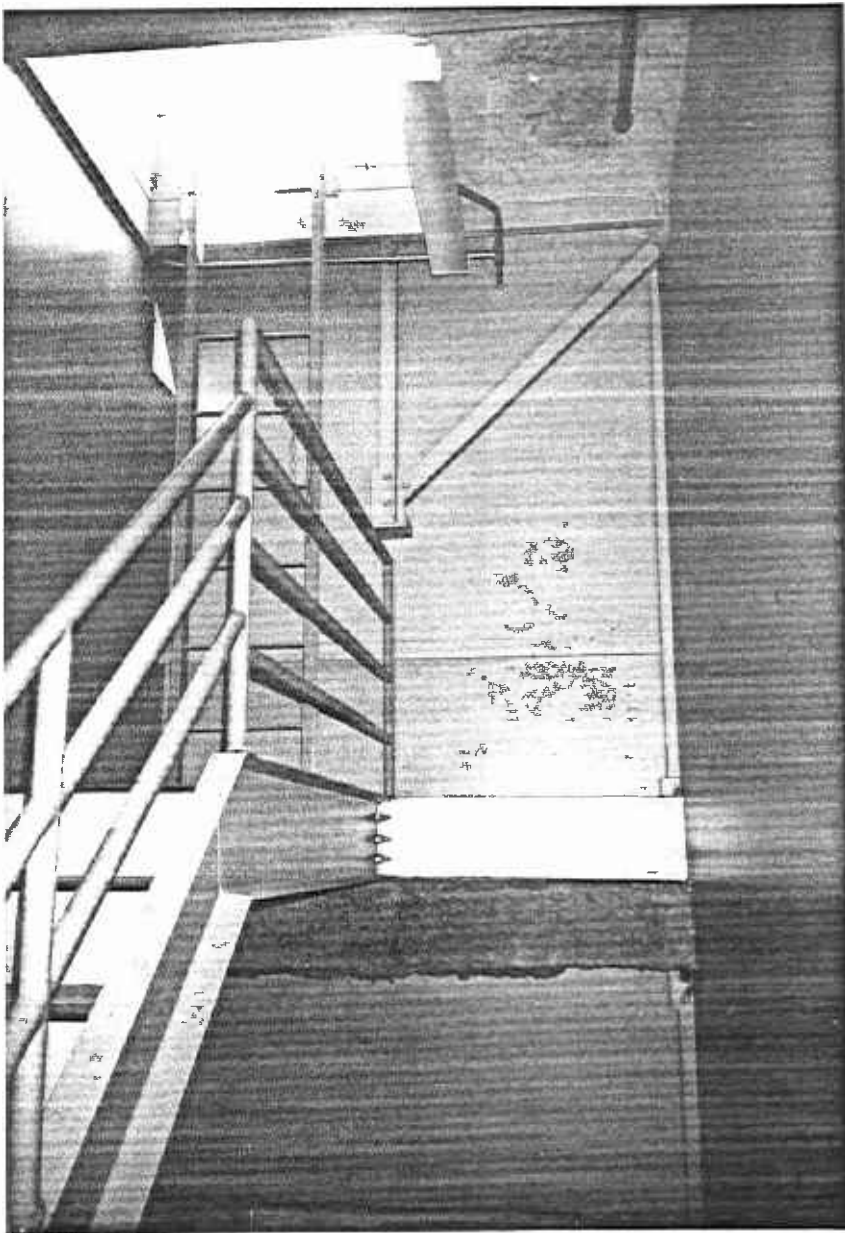
RM. 156- COLUMN B-17.



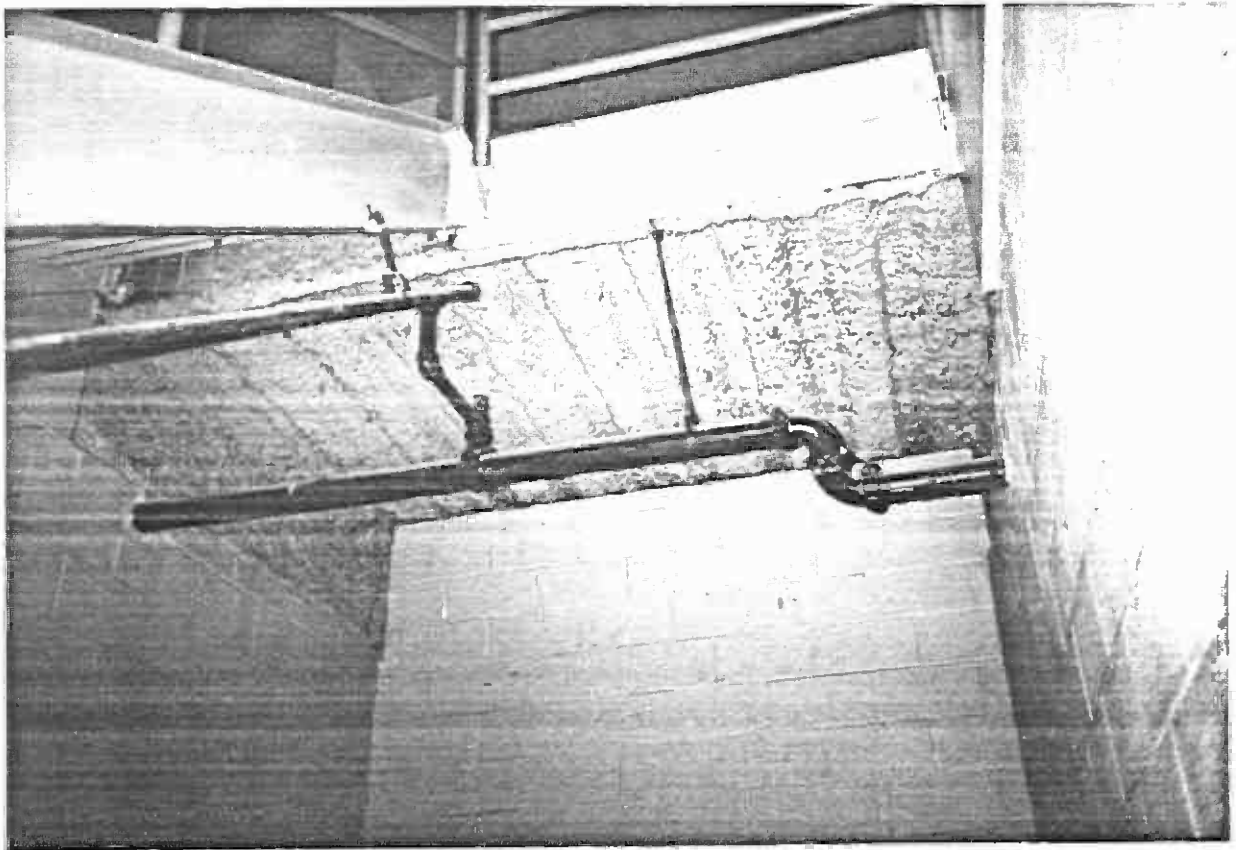
RM 156- JAMB AT B.8-1 W/ CONTROLLER



RM 156- JAMB AT B.8-1.

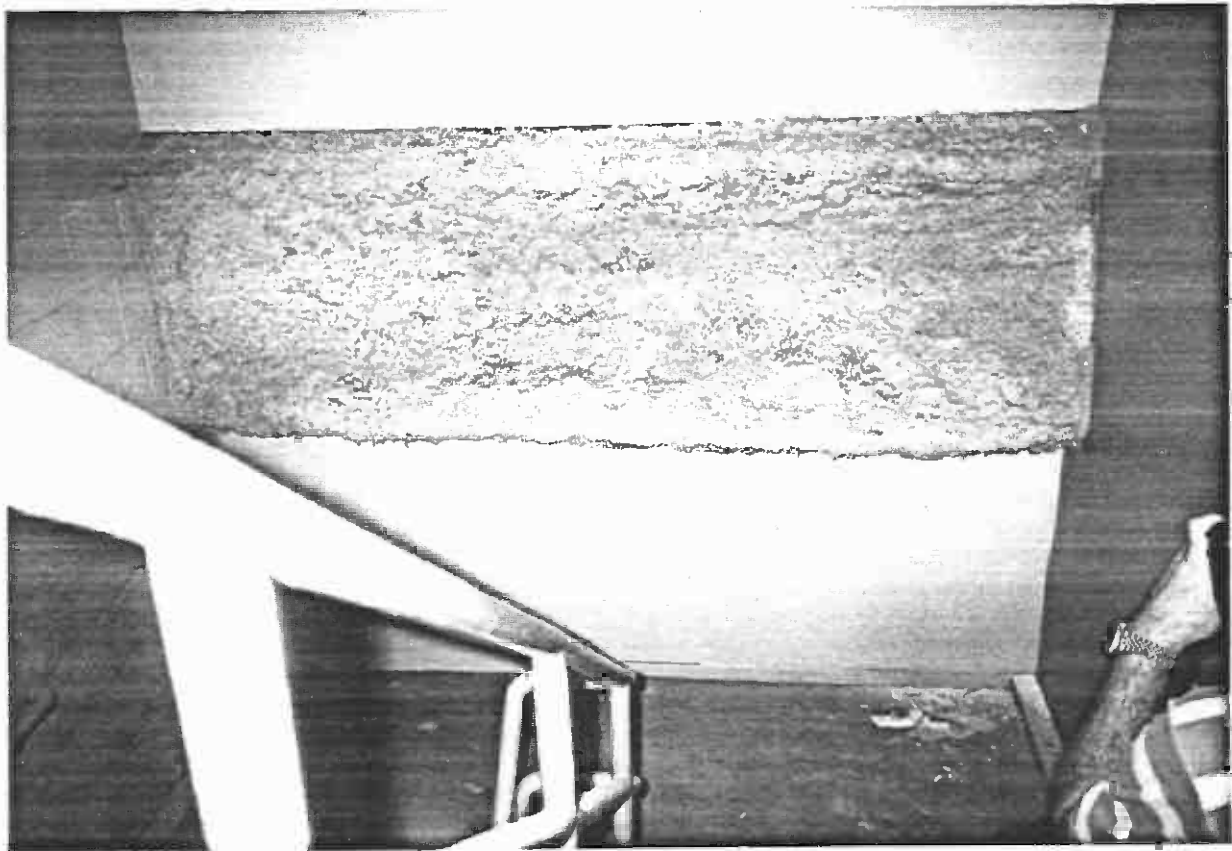


RM. 158- STAIR NO. 7- FIREPROOFING ON EXP. FRAMING.



RM. 154- STAIR NO. 4- EXP. FIREPROOFING UNDER LANDING.

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RM. 136- STAIR NO. 3- FIREPROOFING ON EXP. FRAMING

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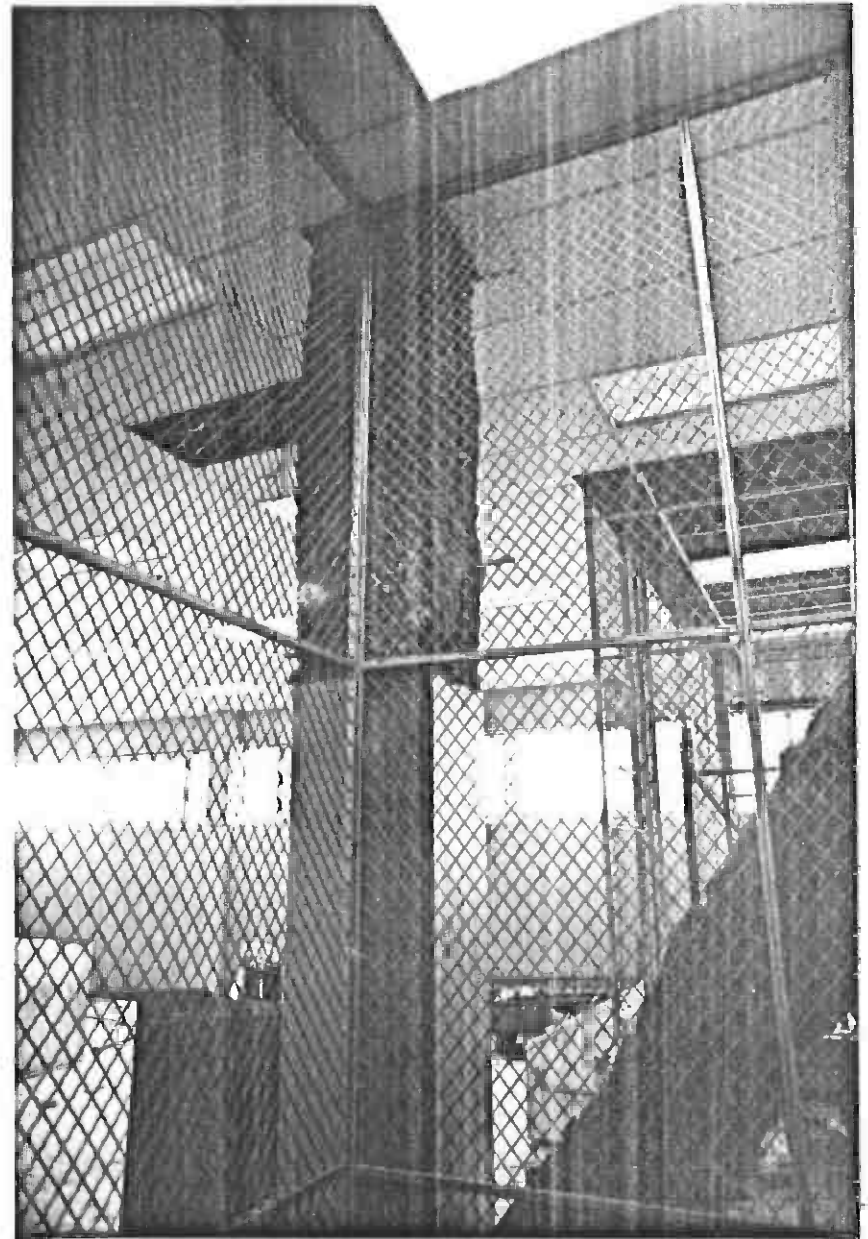
RM 134- COLUMN F.6-14.



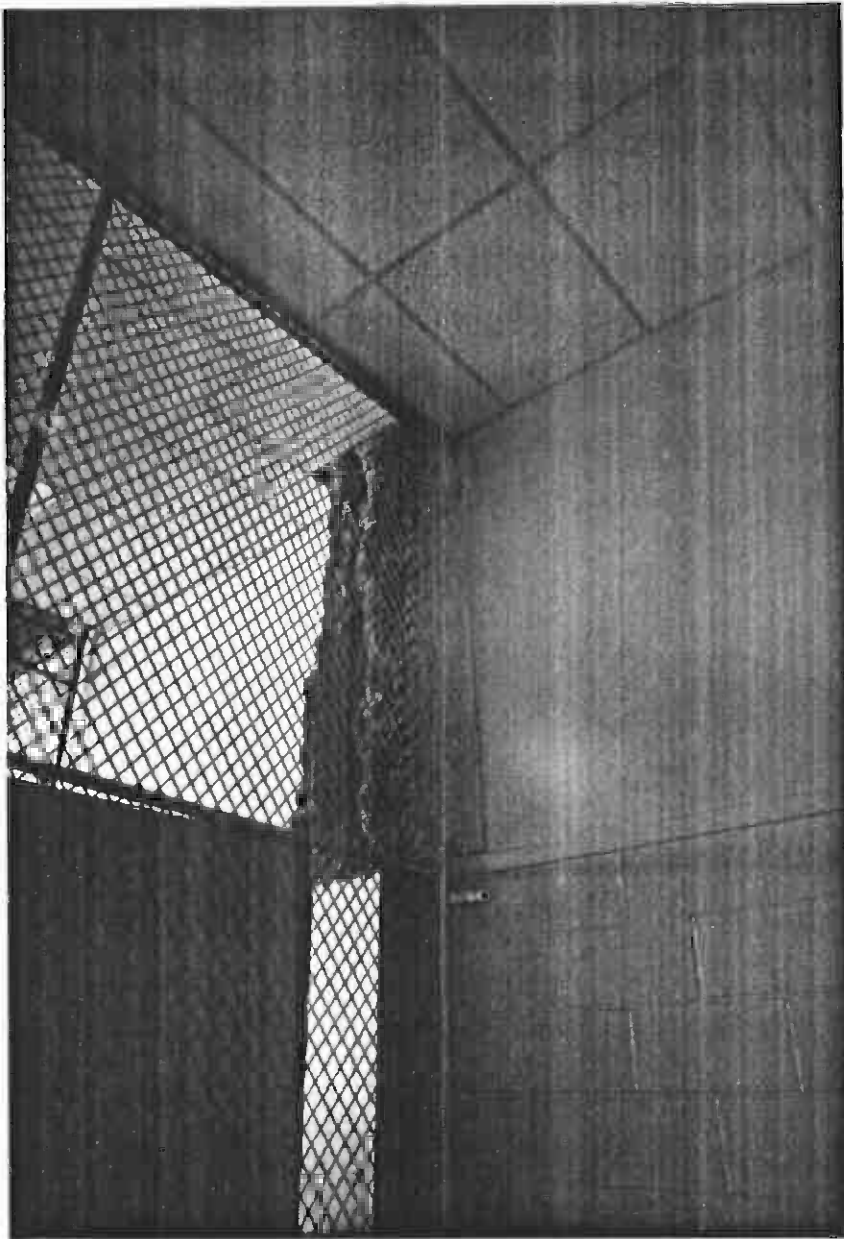
RM 134- COL F.6-14 W/ K-BRACING



RM. 134- COL. F.6-15 W/ K-BRACING

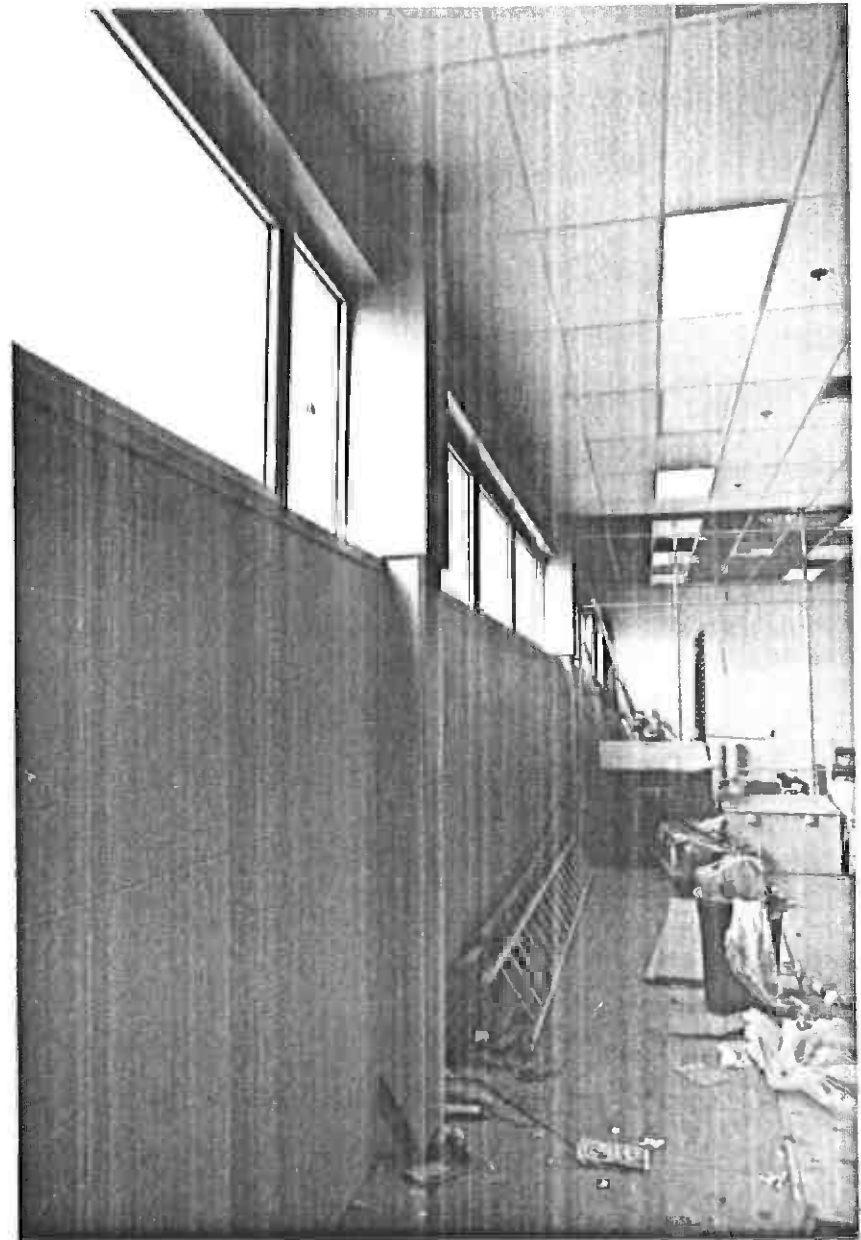


RM. 134- COL. F.6-15 BEHIND PARTITION



RM. 134- COL F.6-14 BEHIND PARTITION

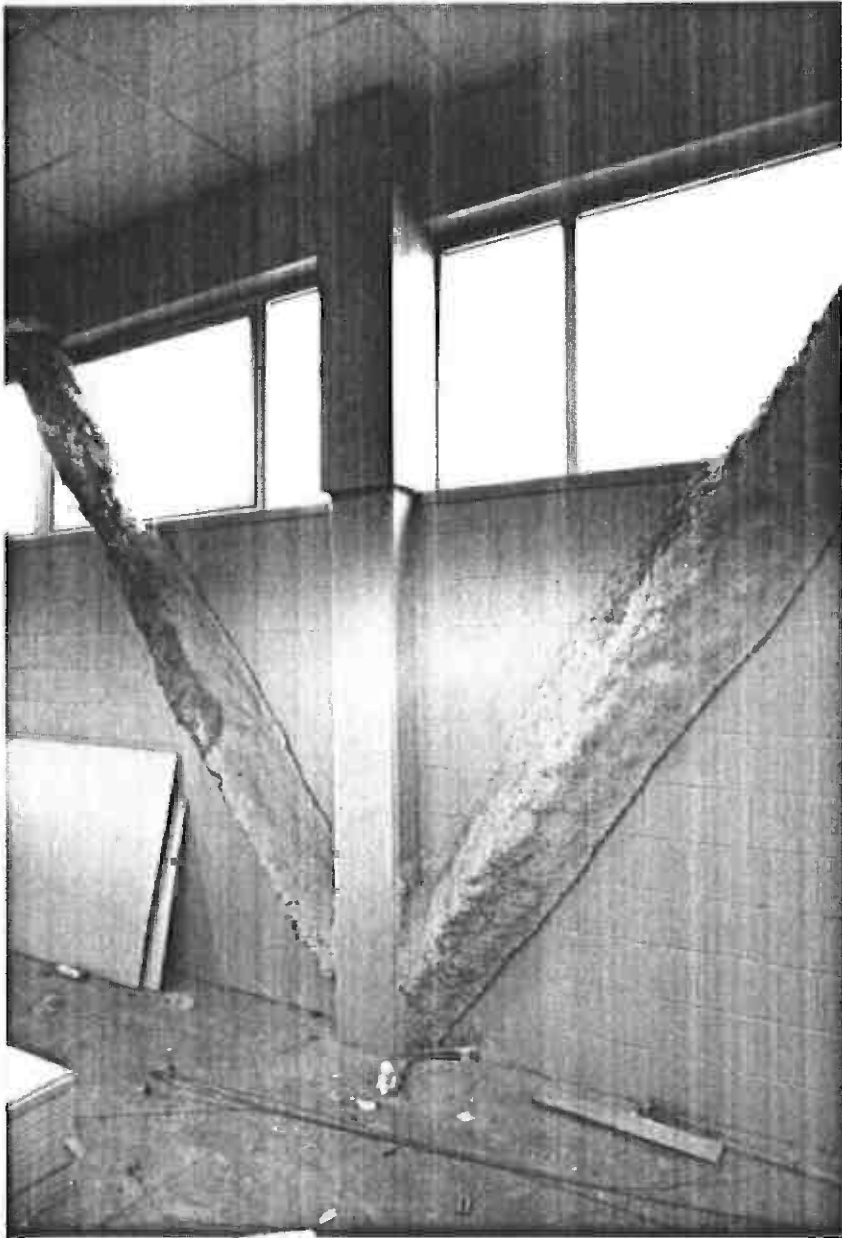
58



RM. 134- CQL G-16.

59

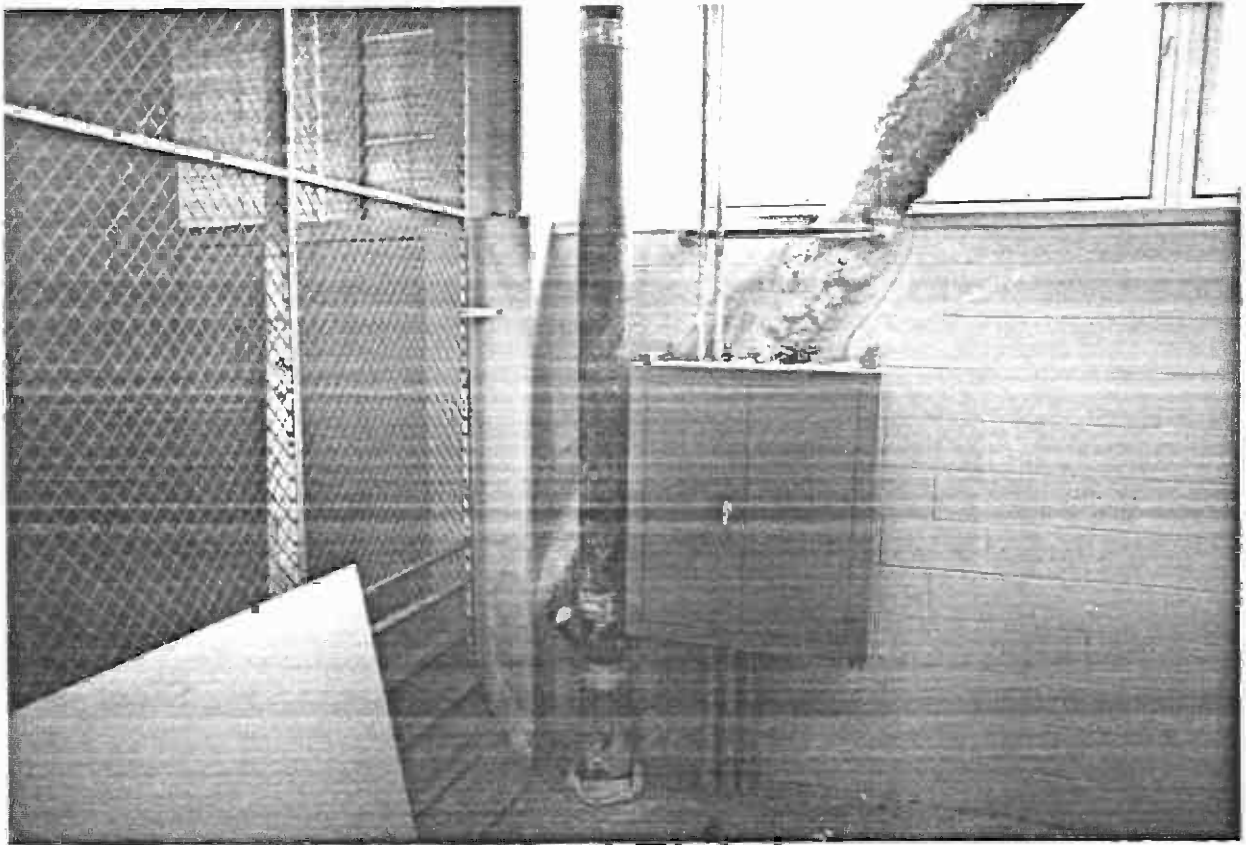




RM. 134- COL. G-18 & BRACING W/ PATCHING

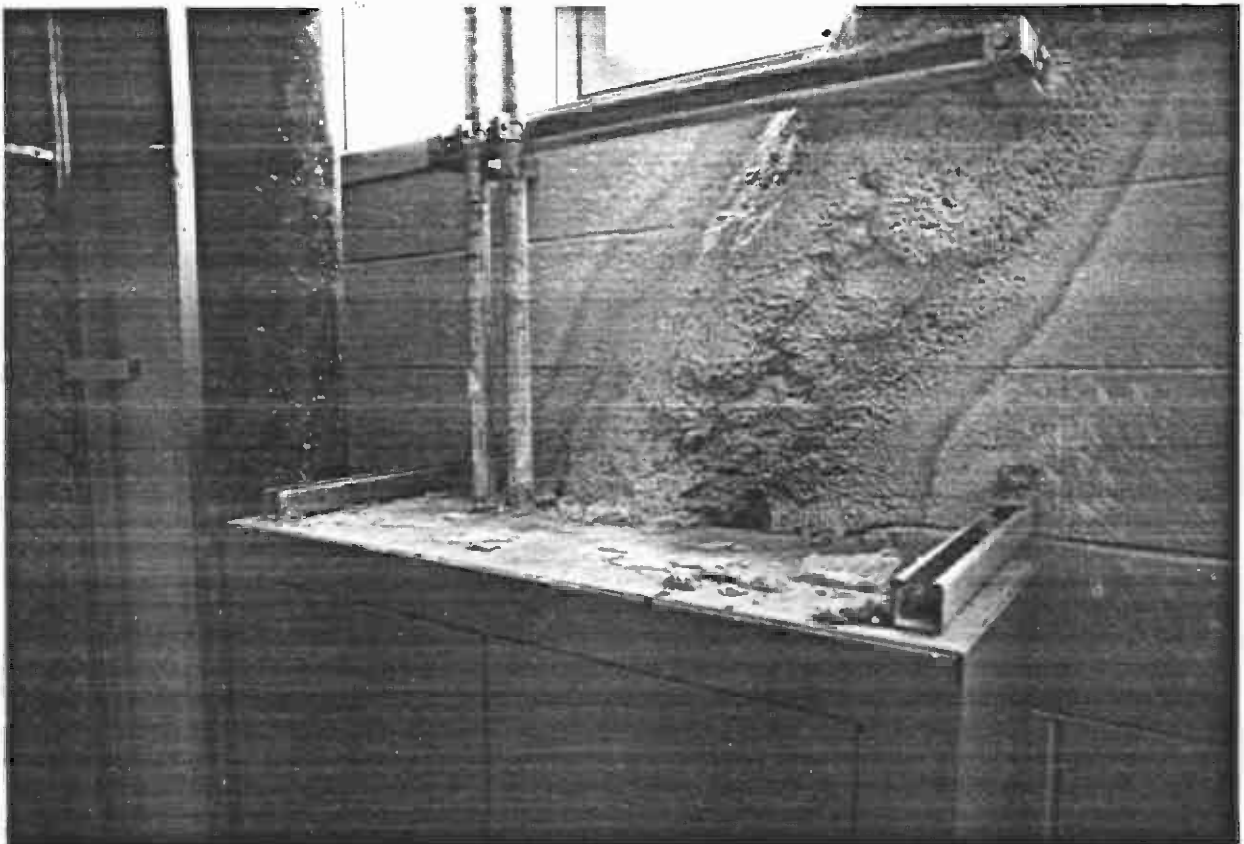


RM. 134- COL. G-18 BRACE BEHIND DRAIN LINE



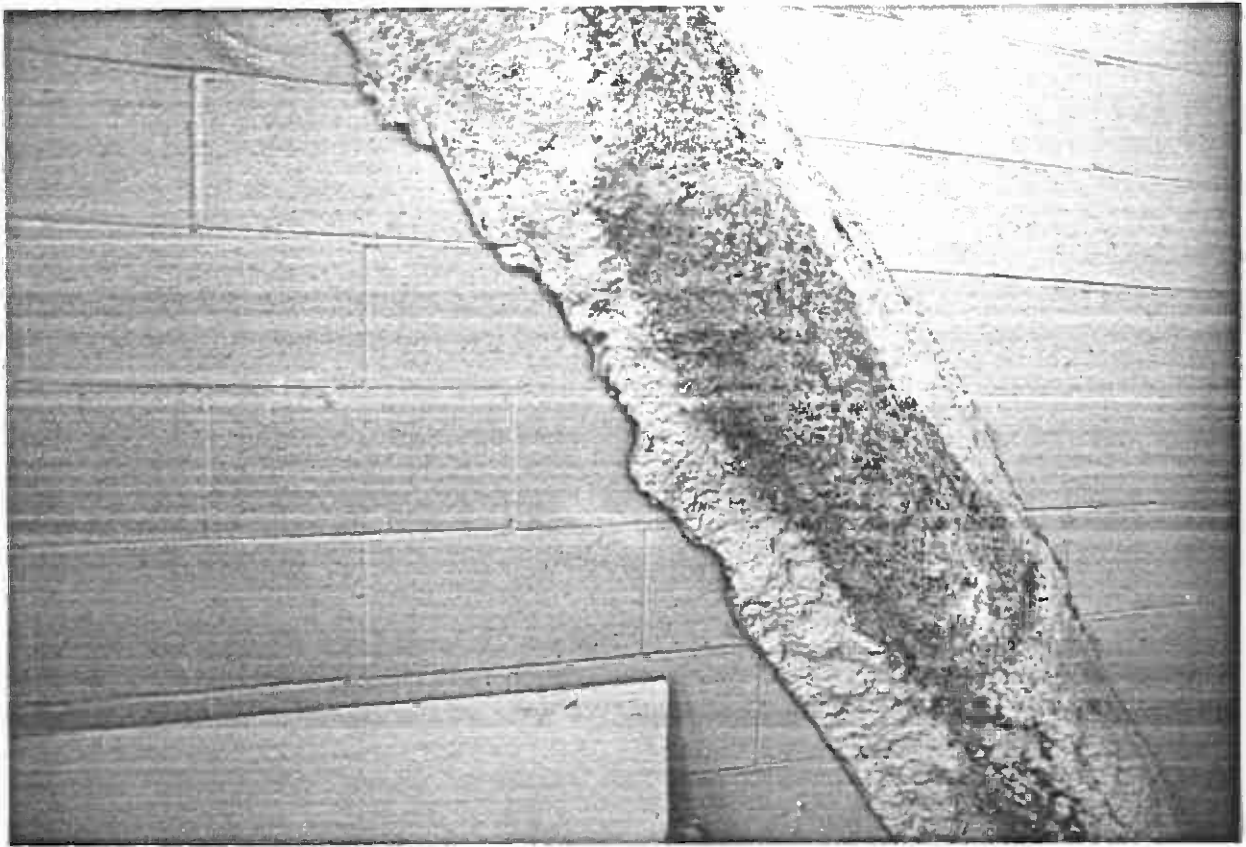
RM. 134- COL G-18 K-BRACING BEHIND BOX & DRAIN LINE

62



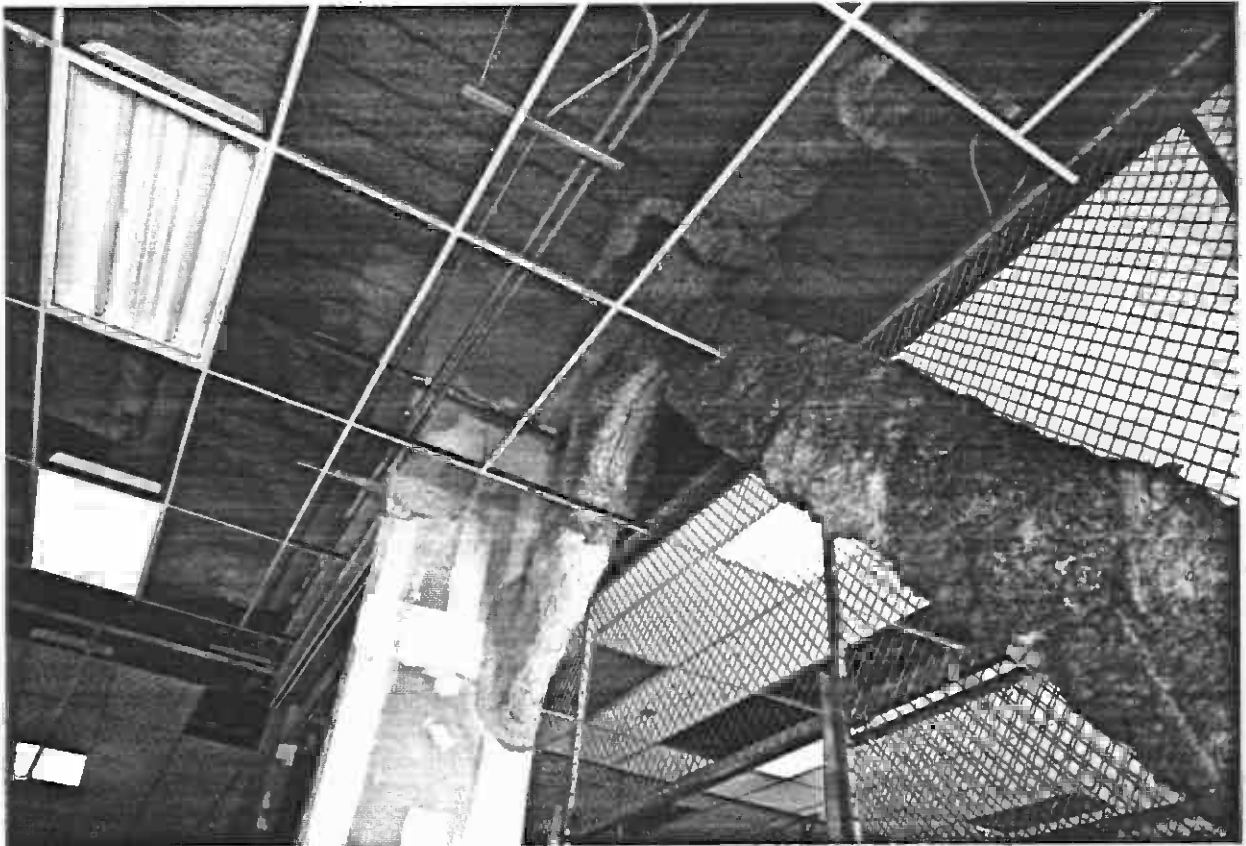
RM. 134- COL G-18 K-BRACING AT ELEC. PANEL BOX

63



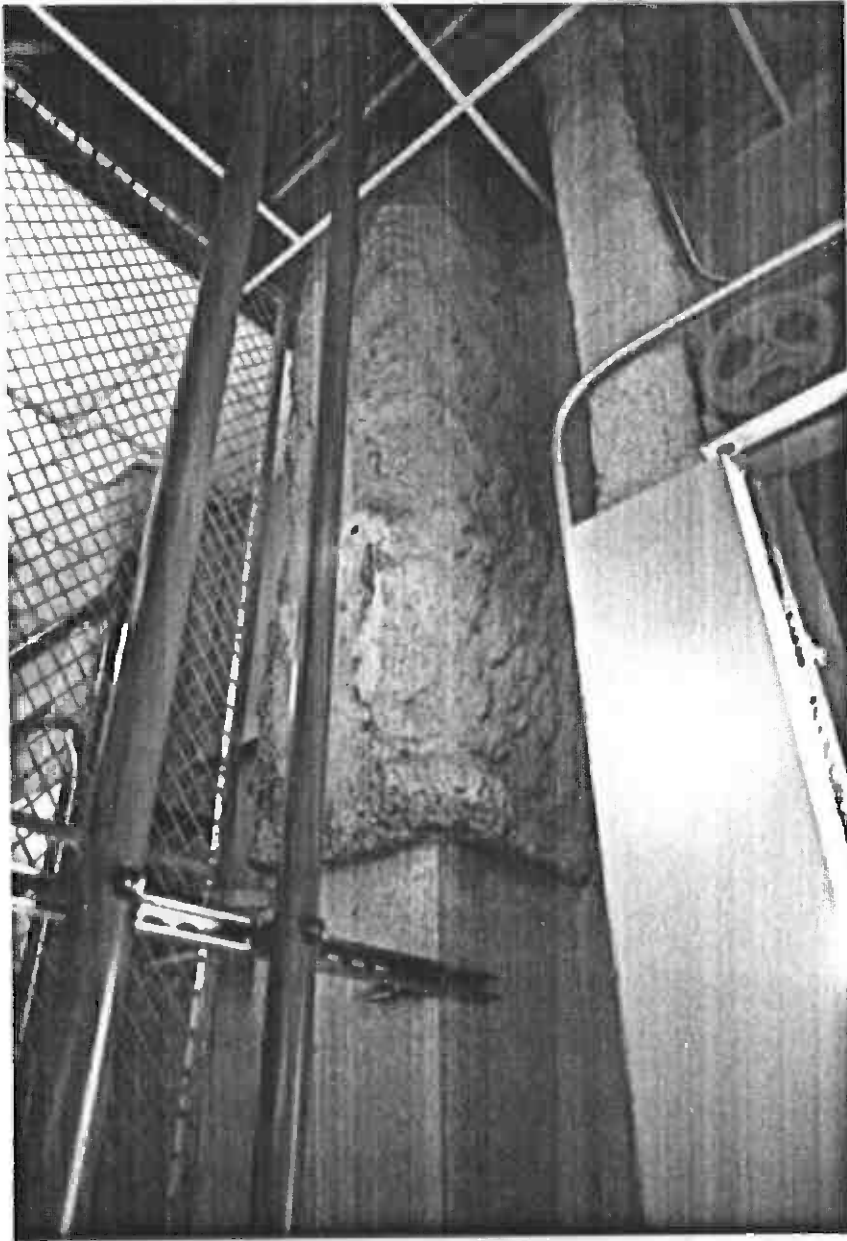
RM. 134- K-BRACING AT G-18 W/ MONOKOTE PATCHING

64

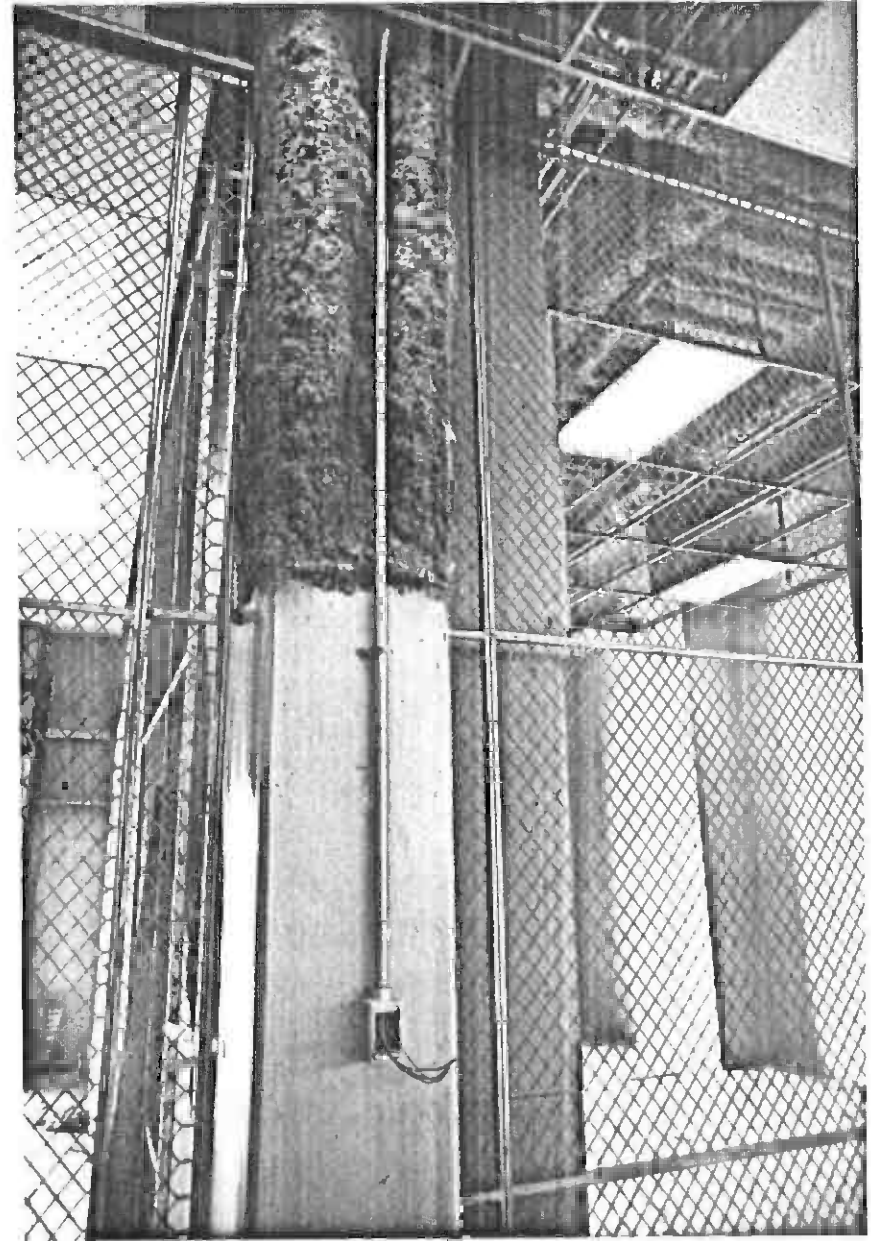


RM. 134- COL & K-BRACING AT F.6-19.

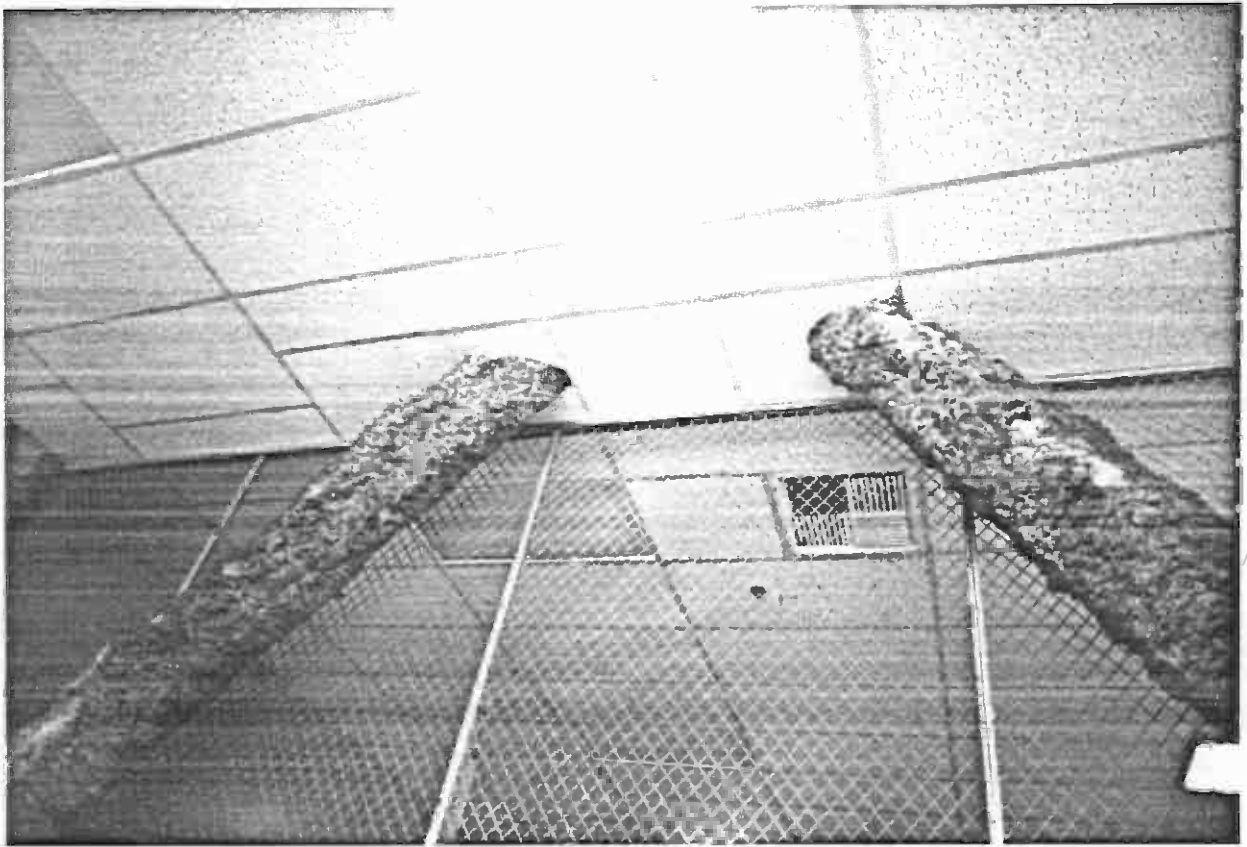
65



RM 134- COL F.6-20



RM. 134- COL F.6-19 W/ SURF. MNTD. CNDUT.



RM. 134- K-BRACING FROM COL. F.6-14 TO F.6-15.



RM. 134- GRIDLINE F.6.



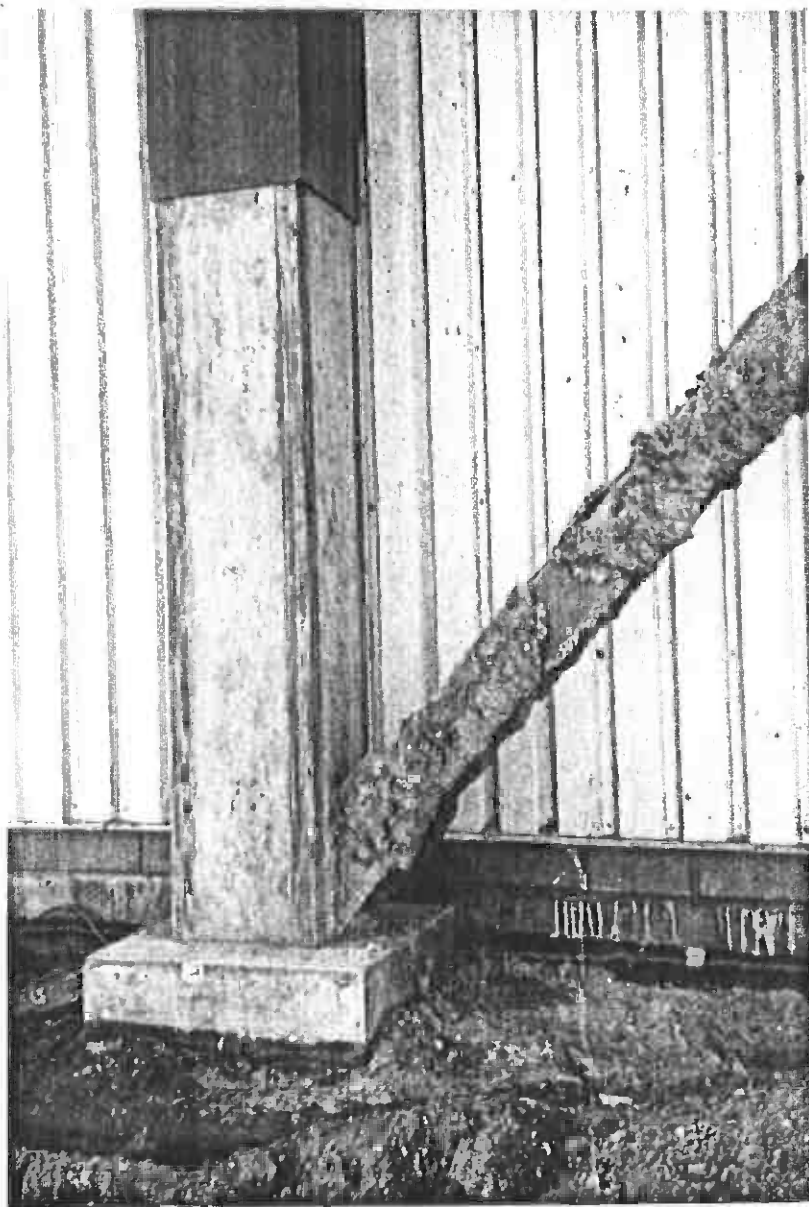
RM. 134- COL F.6-16 W/ BRACING

70



RM. 134- COL F.6-18

71



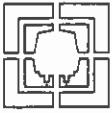
EXTERIOR K-BRACE AT COL 1A-27

72

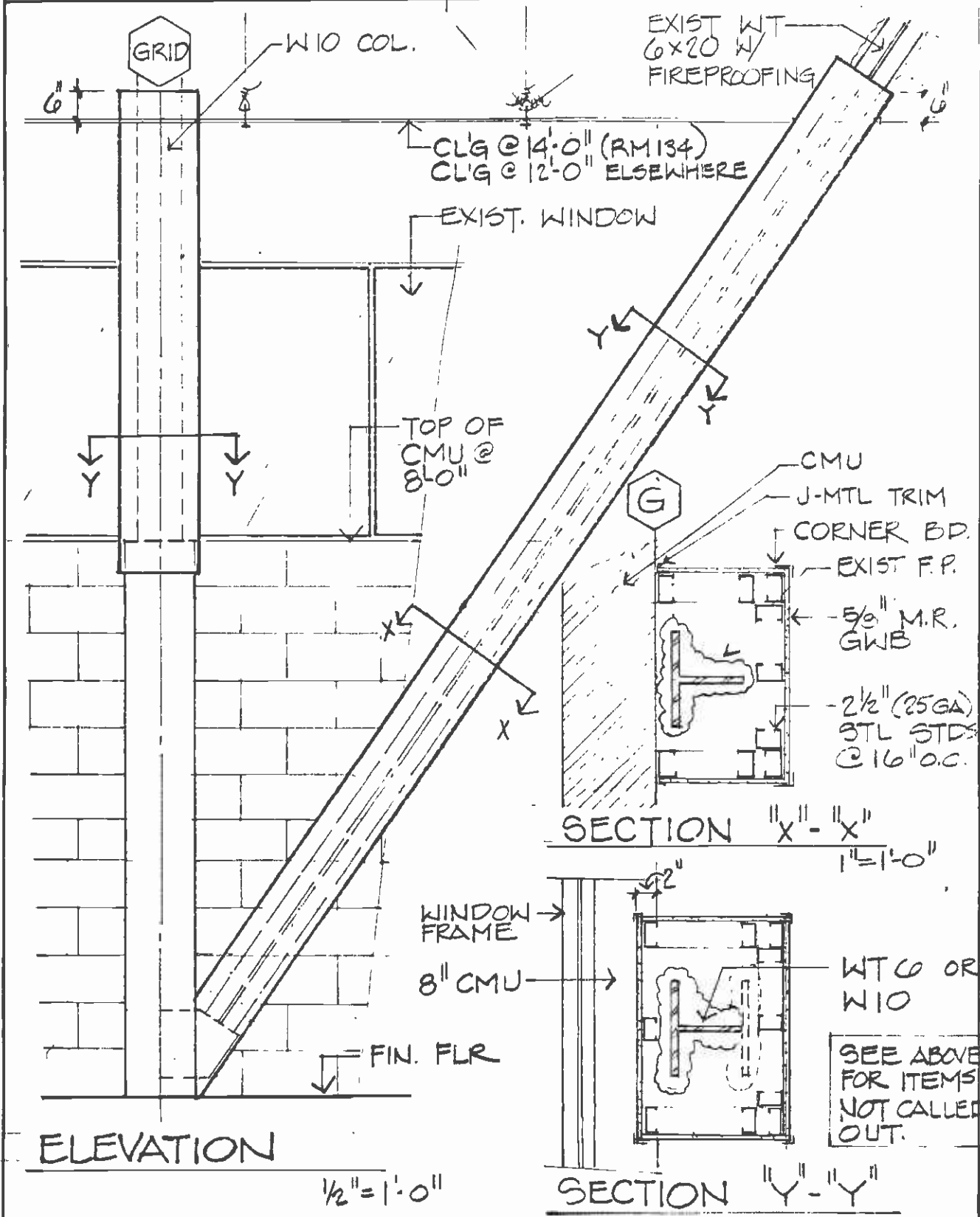


EXTERIOR K-BRACE AT GRIDLINE 1A

73



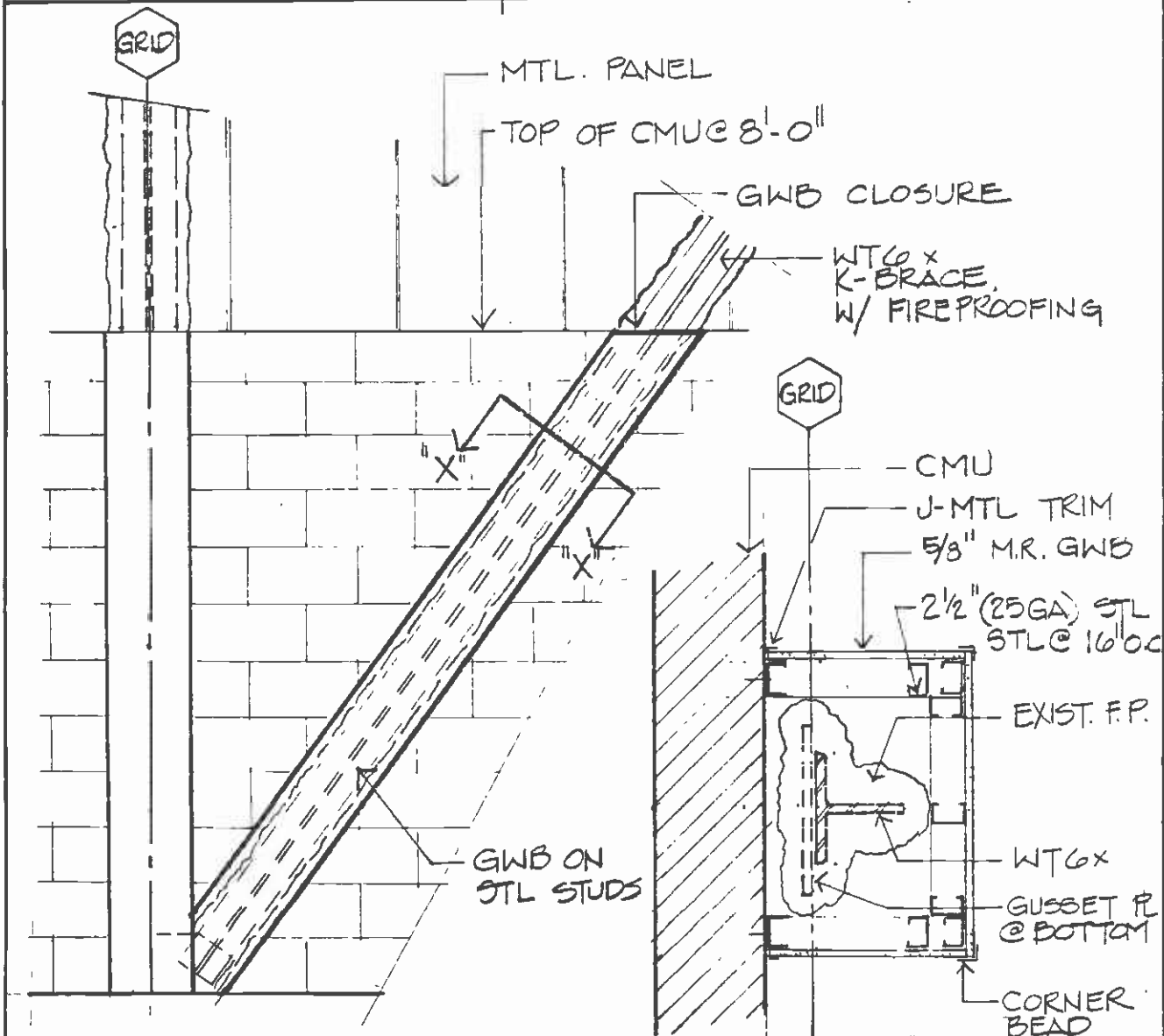
PROTECTION OF FIREPROOFING @ GRIDLINE G	JOB No. A-112	SHEET No.
REPAIR TYPE II refer to para. IV(J)	DESIGNED BY MATHEWS	DATE
	APPROVED	







PROTECTION OF FIREPROOFING	JOB No. A-112	SHEET No.
	DESIGNED BY MATHews	DATE
REPAIR TYPE III refer to para IV(B,F,H)	APPROVED	

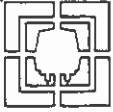


ELEVATION

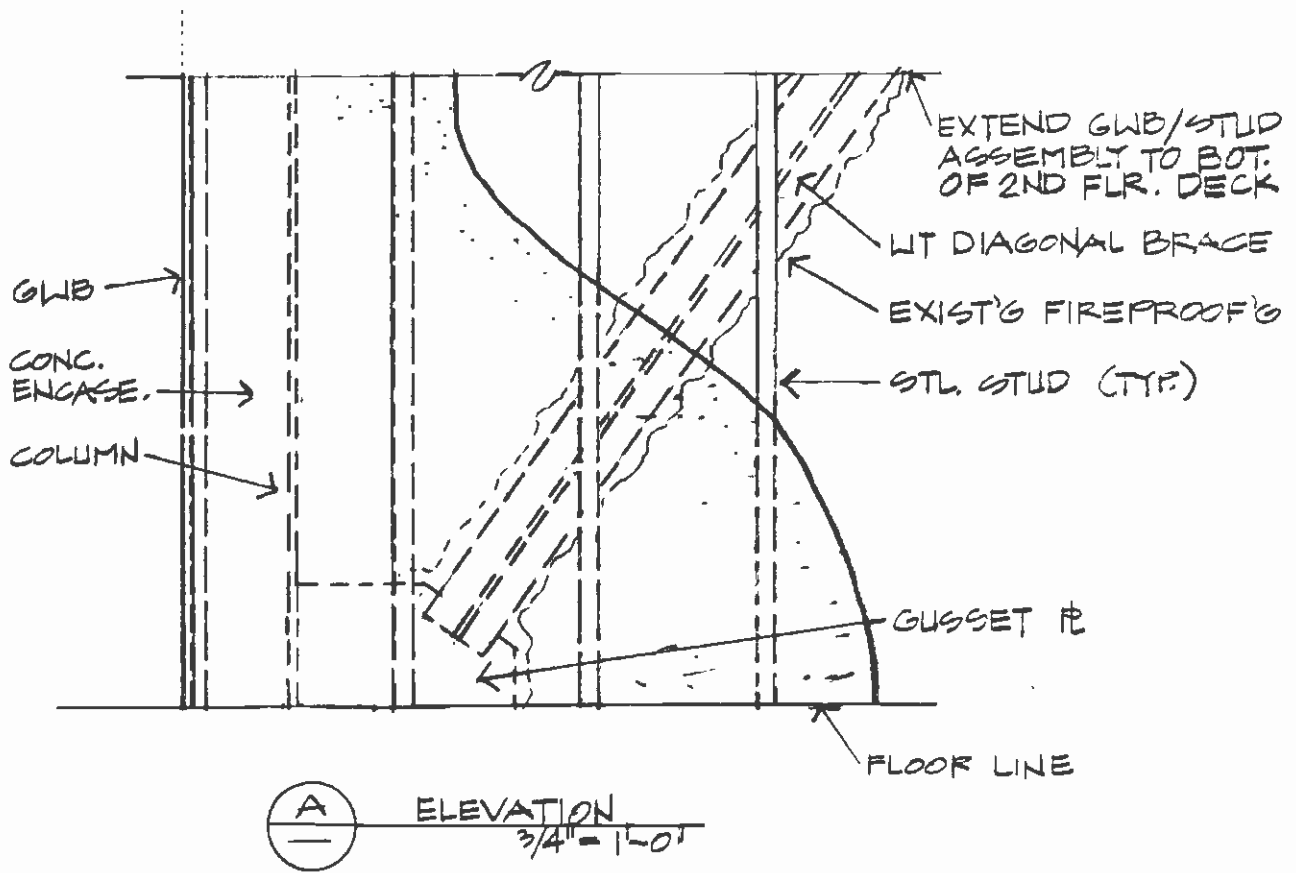
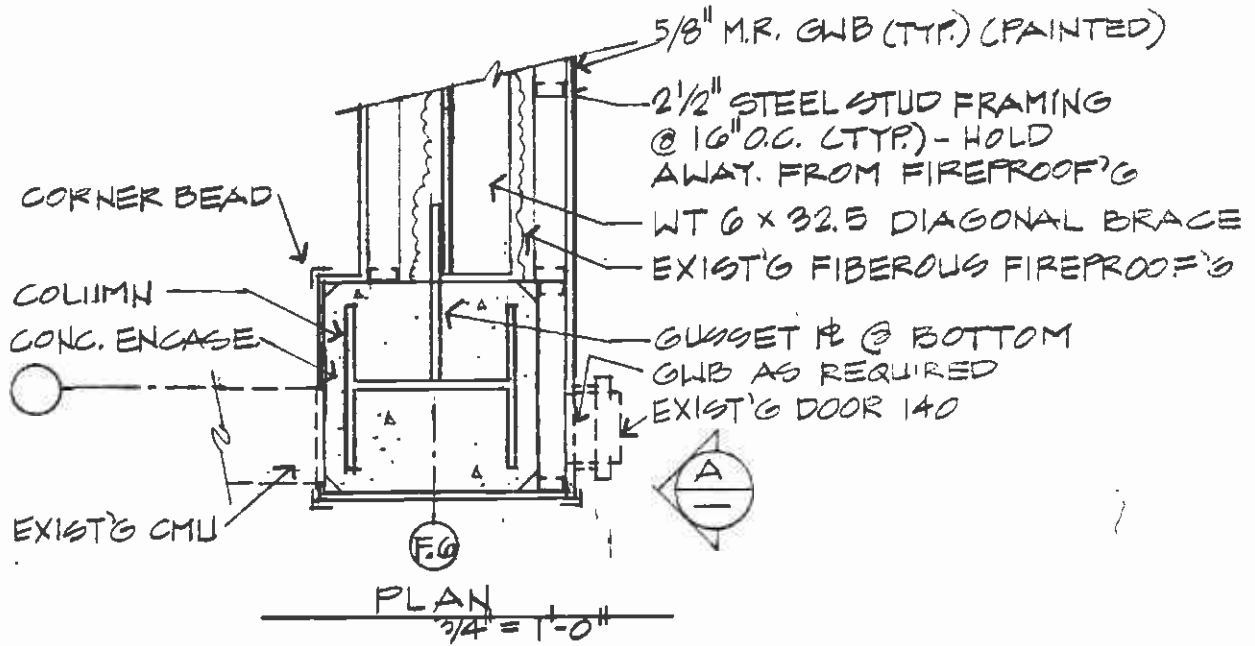
1/2" = 1'-0"

SECTION

1" = 1'-0"

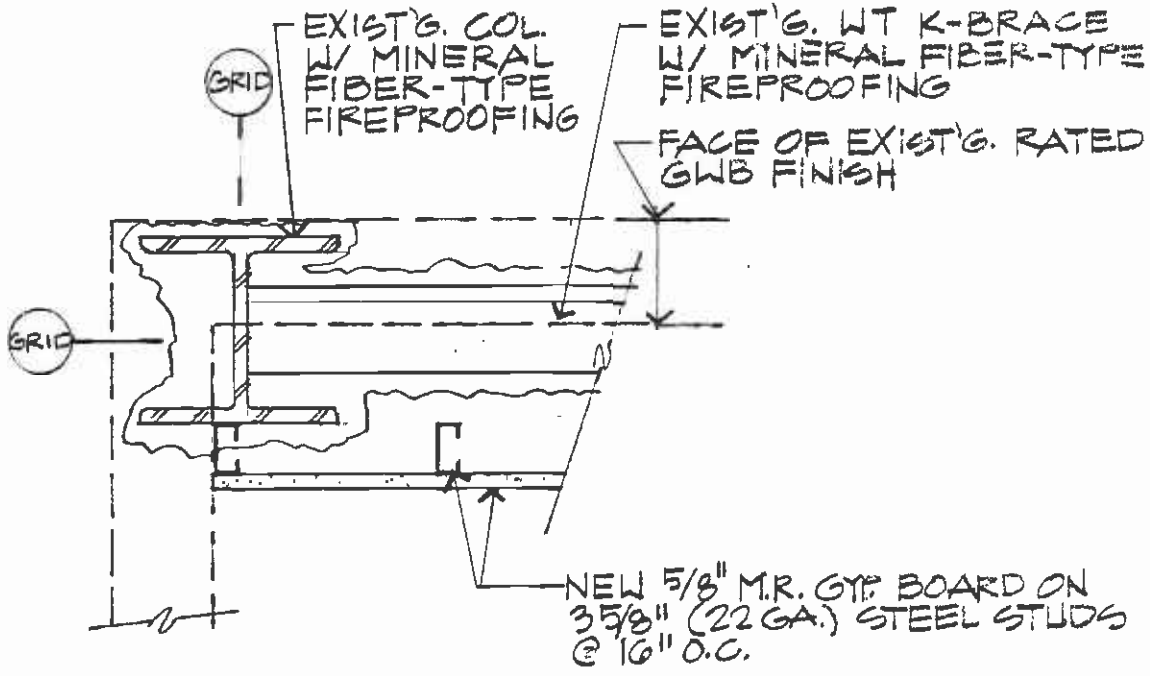


PROTECTION OF FIREPROOFING	JOB No. A-112	SHEET No.
@ GRIDLINE FQ	DESIGNED BY MATHENS	DATE
REPAIR, TYPE IV REFER TO PAR IV(U)	APPROVED	

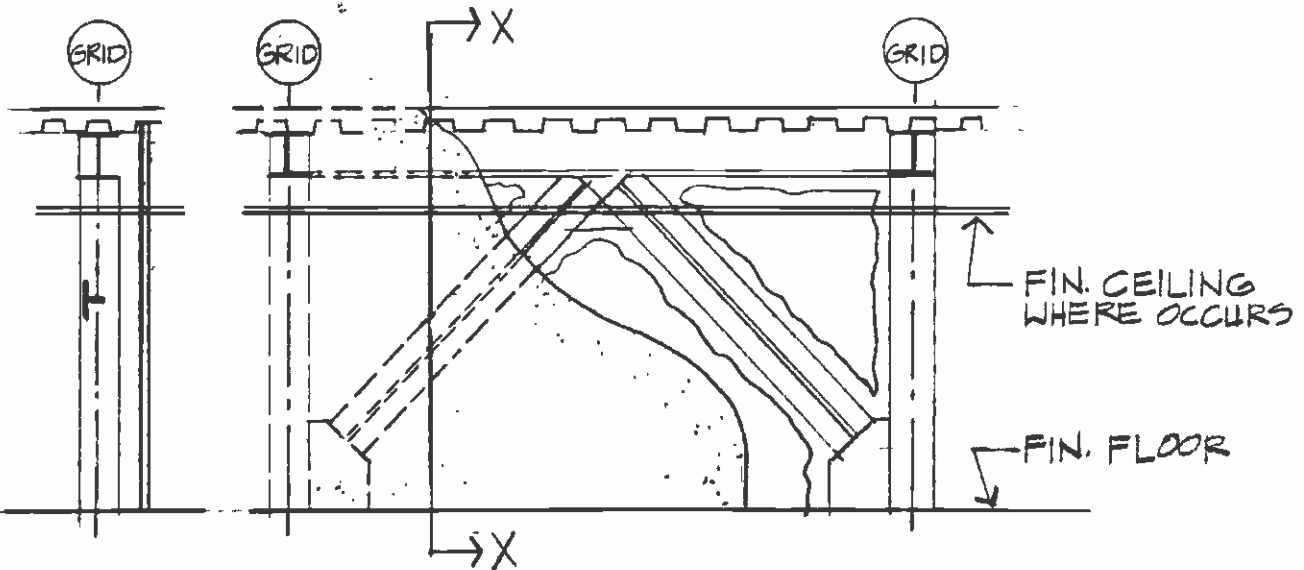




PROTECTION OF FIREPROOFING	JOB No. A-112	SHEET No.
	DESIGNED BY MATHEWS	DATE
REPAIR TYPE V refer to paras IV(b, d & g)	APPROVED	



PLAN  
SCALE 1" = 1'-0"



SECTION X-X N.T.S.      ELEVATION N.T.S.