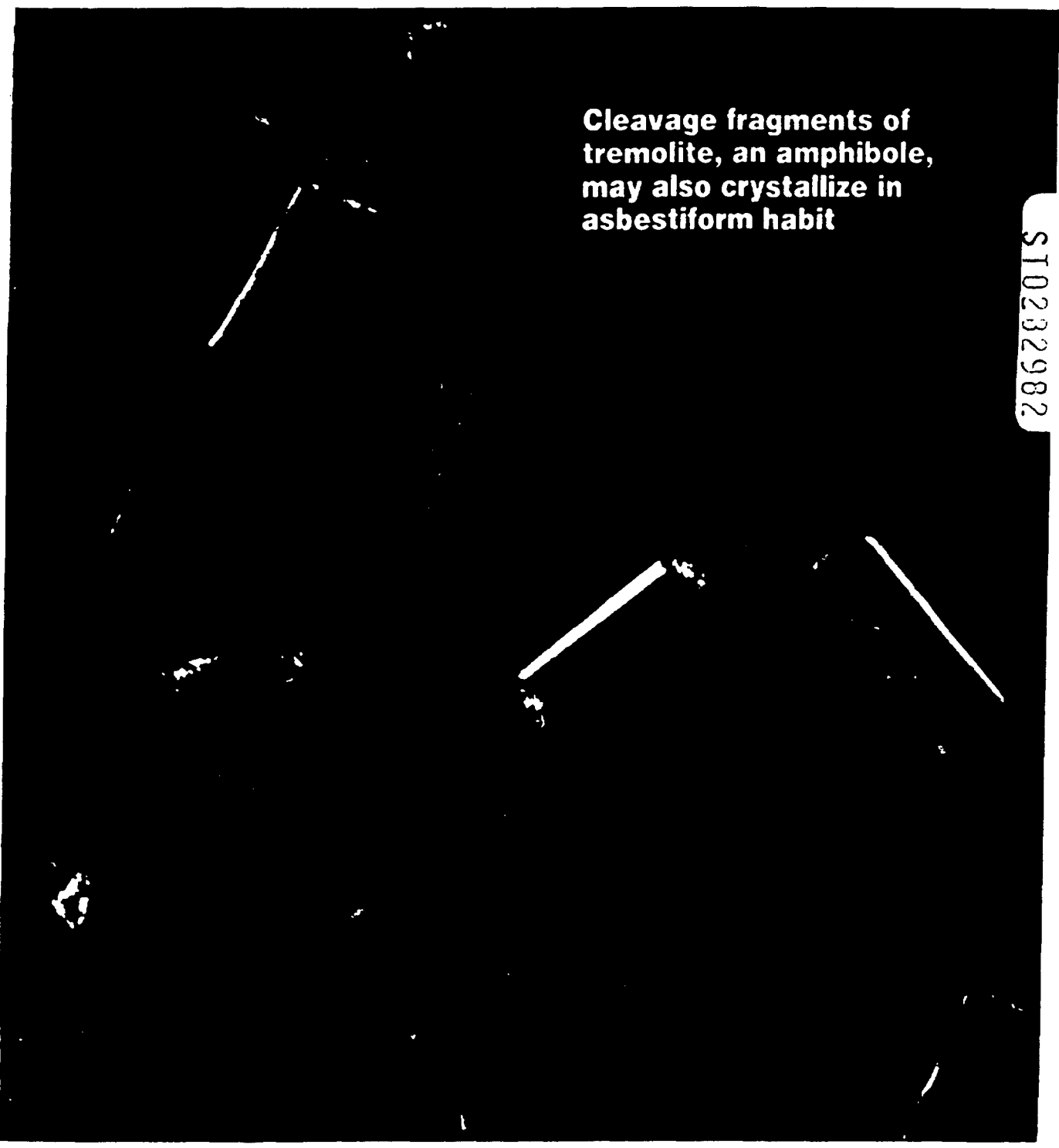


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SPECIAL SECTION

ASBESTOS

MARCH 1989



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may also crystallize in
asbestiform habit

S102332982

Installing Sprinklers in High-Rises May Result in Exposure to Asbestos

Activities disturbing asbestos-containing fireproofing may pose some problems for building occupants

Many workers in high-rise buildings may risk low-level airborne asbestos exposure. This is especially true in buildings where asbestos-containing fireproofing has been sprayed onto structural steel beams and deck.

PAST PRACTICES. Many cities, as part of past building practice or code mandates, required the spray-on application of ACF on structural steel surfaces enclosed by architectural ceilings. The mechanical design typically uses the overhead space as a return air plenum, which results in building-wide distribution of air that flows constantly across an asbestos surface.

ACF often adheres poorly or flakes. A common fireproofing product, for example, consists of approximately 25-percent asbestos fiber in a mineral wool matrix. This product was sprayed onto structural steel surfaces, creating a very dry, fluffy coating conducive to drop-off and susceptible to damage by the slightest mechanical disturbance.

The tendency of ACF to flake is coupled with the common practice of using high percentages of recycled air in buildings, with little dilution by intake of fresh air. The resulting potential for airborne asbestos fibers in the general building air supply is a cause for concern. This potential problem is compounded by the amount of disturbance that occurs above the ceiling during normal daily building operation.

Renovations occurring throughout the life of the building are likely to disturb the ACF. Such activities as partition removal or relocation, light fixture replacement, alteration of electrical conduit, plumbing pipes and HVAC ductwork, and upgrading of telephones and computer lines are common disturbances.

Such long-term, low-level disturbance releases substantial quantities of airborne asbestos into the surrounding area, and possibly into the building air supply. Fibers may thus be carried throughout the building if not controlled by HVAC isolation, wetting and other appropriate operations and maintenance procedures. This hazard is not

well identified, nor adequately addressed by building managers.

NEW REQUIREMENTS. Recent state and municipal regulations mandating sprinkler retro-fit in multi-story buildings will require construction activity in the overhead plenum. Installation of the piped water supply will probably result in significant disturbance of any ACF present.

For example, the Commonwealth of Massachusetts and the city of Los Angeles currently require buildings taller than 75 feet and built before 1975 to install automatic sprinkler systems. These must be in accordance with the state building codes, and the installation is to be phased over a 10-year period. Many other cities are contemplating or enacting similar statutes.

A fire safety expert should design system to limit ACM disturbance.

Building owners who recognize their potential liability in this situation may, under ideal circumstances, conduct full asbestos removal before the due date. However, they seldom have the finances or the inclination to spend large amounts of money—approximately \$20 to \$35 per square foot—for removal of asbestos fireproofing to accommodate the installation of sprinklers.

Therefore, options must be devised to allow compliance with sprinkler upgrade mandates while minimizing the disturbance to the asbestos material. However, since full asbestos removal is not feasible in most situations, these options must be compatible with the building operation and associated with a cost so that informed decisions can be made.

SPRINKLER SYSTEMS. A sprinkler system consists of an arrangement of piping with associated sprinkler heads and control valves, a detection system and an automatic water supply. The system is engineered to meet the requirements of a specific space, which in the case of multi-use/multi-tenant high-rise buildings requires special considerations in design and installation.

Constant turnover of tenants and space use, combined with periodic architectural renovations, requires an inherent flexibility in the base piping instal-

lation. This will accommodate these continual changes and any necessary sprinkler upgrading. (Fig. 1)

The physical configuration of the piping system and water flow controls falls within a few major varieties. Newer, fast pipe-connection techniques with lightweight piping favor the grid layout. (Fig. 2.)

The more traditional tree configuration with a main supply and branch lines, (Fig. 3), and loop systems are also common.

In wet systems, the piping is always filled, which offers immediate release of water when activated by the detection/alarm system. Dry pipe systems are generally in use in situations where cold temperatures pose the threat of pipe freezing. The response is not as rapid in a dry system, for the air must be expelled from the system before water can flow from the sprinkler heads.

Municipal water typically supplies sprinkler systems. If pressure and/or volume is inadequate, fire pumps and possibly a suction reservoir supplement the system. In this situation, the municipal supply maintains a storage capacity from which water is drawn in the event of fire. In many areas, plans of a particular system require review and approval by local code officials, after design by a professional engineer.

EVALUATION. Initial analysis of fire protection needs are based upon building codes, building classification, space uses, water sources and several other parameters. Because sprinkler installation—like any activity in the overhead plenum of a fireproofed building—has the potential to disturb asbestos, the primary evaluation must integrate sprinkler design with various asbestos abatement options.

Designing the installation requires expertise from various disciplines. To accurately determine the impact on the ACF, the environmental consultant must receive a clearly defined sprinkler-system design from the fire and safety consultant. The extent, condition, mineralogical content and type of ACF will greatly influence sprinkler design.

For example, fireproofing that exists only on the beams with minimal overspray onto adjacent surfaces can use somewhat less rigorous environmental controls than if the entire structural surface is coated.

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By Wm. Chip D'Angelo, president, and T. Michael Volatile, chief estimator, Kaselaan & D'Angelo Associates Inc., of Los Angeles, New York, Philadelphia, Boston and Haddon Heights, N.J.

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SPRINKLERS

(Continued from page 40)

The integrity of a material can be described by its adhesion and/or cohesion. Adhesion—the ability to bind to a substrate—and cohesion—the ability to bond within itself—can be tested by a standard ASTM method. The results may be of use in assessing the condition of the fireproofing. Material used in ACF may be more or less friable. The common mineral wool matrix ACF is considered more friable than a cement-like product. The most common problem associated with the mineral-wool matrix product is adhesive failure. Large patches may break loose from the underlying steel substrate. This may be caused by rust resulting from poor application conditions or possibly water leaks.

OTHER METHODS. Dust sampling for asbestos can also be conducted in ceilings and other horizontal surfaces in the overhead plenum. The sample will provide an indication of potential asbestos exposure during sprinkler installation. A review of previous air sampling in the building and other inspection information associated with the building's operation and maintenance plan and/or demolition activities should also

be conducted to evaluate potential airborne levels.

A third consideration in the sprinkler design is the mineralogical type of asbestos that will be encountered. Chrysotile, more common than amosite, is the easier to control. Amosite is most often found in high-temperature applications such as boiler insulation, but may also be present in fireproofing. It is

ACM may be disturbed easily, since it often adheres poorly.

resistant to wetting, and thus remains airborne for longer periods of time and has greater potential for spreading and contaminating adjacent spaces when disturbed.

The potential for contamination, as determined by the environmental consultant, will require the integration of varying environmental controls with the location, configuration and phasing of the sprinkler work. Thus, a cost-effective project that limits the uncontrolled disturbance of asbestos material is a result of close coordination and

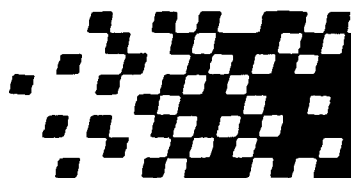
agreement in the design stages between the fire/safety engineer, the environmental consultant and the building owner.

The impact of this sprinkler/asbestos activity must also be discussed with the building engineer, since effective controls are greatly influenced by the operation of the building's HVAC system. Depending on the degree of disturbance, such modifications as blanking supply and/or return air shafts to specific spaces, alteration of fresh air/return mix, variation of fan speed or cycling hours of operation may be necessary.

This is particularly significant when installing sprinklers in a mechanical room with active fan systems, where uncontrolled disturbance of asbestos materials occurs. The problem is compounded by the easy access of airborne contamination to the air distribution system.

CONTRACTORS. Agreement on the bidding and contractor selection process is necessary early in the design phase. Procedures for addressing the asbestos disturbance should be delineated on a set of drawings which accompany the sprinkler plans. After appro-

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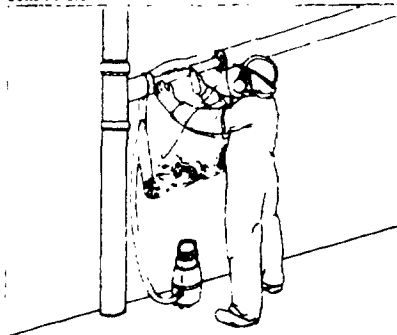
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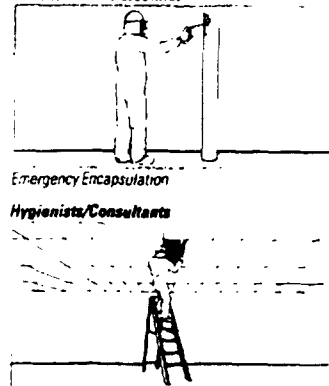
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Table 1

	Advantages	Disadvantages
1. Full-floor removal	Removes ACM hazard. Lower sprinkler cost. No hazard or future renovation. Removes long-term O & M Lower insurance	Highest cost. Lengthy time frame evacuation. Necessitates full renovation. Stringent monitoring program required.
2. Partial-floor removal	Lower up-front costs. Lower sprinklers costs. Limited hazard to sprinkler mechanics or future renovation in these areas. Limited evacuation required.	Higher risk of exposure. Stringent monitoring program required. Complicates O & M program. Recordkeeping difficulties.
3. Full-floor dust control	Lower ACM costs. Higher sprinkler costs. Net lower costs	Increased sprinkler costs. Exposure to sprinkler mechanics. ACM left in place. Significant protection cost with no ACM abatement.
4. Spot removal with local isolation	Area remains occupied. No relocation costs	High potential for area contamination. Exposure to sprinkler mechanics. Lost operations time if leaks

Table 1 offers a comparison of the four abatement options discussed.

appropriate code officials approve the plan, a determination should be made about who can bid on the work—a general contractor, sprinkler contractor and/or asbestos abatement contractor.

Currently, because of insurance and liability issues, many general sprinkler contractors do not wish to use an asbestos abatement firm as a subcontractor. As a result the latter often works directly for the owner.

Tradesmen not related to asbestos removal may also demand a limit on their work in an asbestos environment. This may require that abatement personnel perform some of the sprinkler installation, such as attachment of hangers. However, this has not been very successful.

ALTERNATIVES. Preventing work in the overhead plenum might be a better way to avoid disturbing the asbestos. If the building's architecture allows, sidewall-mounted sprinklers can be used.

It may be necessary to redesign the interior space to accommodate the throw of the sprinkler heads. Since sprinkler lines will be below the ceiling and within view, it may be necessary to install fire-rated soffits or

other architectural modifications to meet code and aesthetic requirements.

Other variables in sprinkler installation may require only minimal contact with asbestos materials. An expanded vertical distribution through existing columns may be possible, which would greatly reduce the work

Building renovations must be considered in system design.

necessary in the overhead plenum on each floor. A single pipe riser for each sprinkler head will avoid the need for the extensive horizontal piping required by normal overhead installation.

In that case, contact with asbestos would only occur when coring through the slab, and this may necessitate construction of false column enclosures to accommodate the supply pipes. Coring can be reduced by effective use of existing chases and columns, and installation of vertical piping within existing walls can reduce the need for

modifications to obscure the piping.

Expanded vertical distribution is also preferable with floor- and wall-mount sprinkler heads. These options trade off the additional costs of sprinkler installation above the ceiling—with the associated problems of asbestos disturbance—with the additional impact costs of installing sprinklers below the ceiling line.

ASBESTOS HANDLING. If participants decide to install sprinklers above the ceiling line, there are four ways to handle the asbestos problem: full-floor asbestos removal, partial-floor asbestos removal, full-floor isolation and dust control, and spot removal with local isolation. These must be able to accommodate the requirements of the specific sprinkler design.

The installation of water supply lines logically involves removal of ceilings—often suspended panels and/or interlocking spline—for access to the space above. The simple task of ceiling removal in itself can often result in significant exposure to asbestos because of the usual drop-off of ACF onto the ceiling surfaces.

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SPRINKLERS

In worst-case situations, substantial drop-off has resulted in layers of bulk asbestos debris. In this case, all personnel involved with the sprinkler project are at risk. Even the preliminary engineering survey necessary for the design and planning phases may result in asbestos exposure.

MAPPING. Once the installation begins, it is necessary to inspect the plenum to map the specific route of the lines. Pipe lengths are subsequently placed into the plenum to check the routing. Often, this disturbs the ACF and other asbestos-contaminated surfaces such as conduit, domestic water pipe, ductwork and computer cables.

Next, connections of feed pipe are made, and hangers are necessary for proper support. The hangers are either attached to the deck, which requires a power tool to drive pins, or from the flange of beams, using a clamp device (Fig. 4). Both of these operations frequently necessitate direct contact with the ACF and cause the release of airborne fibers.

Using a power driver for deck installation causes vibration, which can

cause ACF drop-off outside the immediate area. Installing branch piping requires drilling into the main trunks and making more connections. These, in turn, may require drilling and/or cutting of steel beams to accommodate the runs. The final leak test also has the potential for large-scale disturbance, since inadequate installation will result in significant water

Wet systems offer immediate release of water when activated.

spraying onto an asbestos fireproofed deck.

Asbestos controls during sprinkler installation are clearly a crucial precaution to protect workers, prevent the spread of asbestos materials and avoid spreading asbestos contamination throughout the building.

FULL-FLOOR REMOVAL. The first option to consider before sprinkler installation is total asbestos removal. This would obviously preclude asbestos controls for the sprinkler phase, since installation would occur in an

asbestos-free zone.

Full-scale asbestos-removal procedures requiring building HVAC isolation, evacuation of the space, and stringent containment, decontamination and disposal procedures are time-consuming and costly. Normal construction costs for demolition of existing ceilings, removal of asbestos fireproofing and installation of a re-spray product are between \$20 and \$35 per square foot.

Asbestos removal in a 20,000-square-foot space may take four to six weeks. The cost of re-location of office personnel from the space, as well as losses incurred from this operational downtime, are additional items to be considered.

Other disadvantages associated with large-scale asbestos removal are the costs of matching and/or replacing acceptable lighting, ceilings and other interior finishes. Depending on the particular space, unique architectural features that are either irreplaceable or cost-prohibitive to re-install will not survive the demolition activities.

Long-term advantages of asbestos removal are the potential for lower property insurance—when asbestos is

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removed and replaced with sprinklers—and higher property values.

PARTIAL-FLOOR REMOVAL. Asbestos removal costs can be reduced by limiting it to those areas where most of the sprinkler work will occur—the main trunk areas. However, the same procedures for asbestos removal as for an entire floor—HVAC isolation, area containment, and so on—must be carried out. While this does allow the main trunk installation to occur in an abated space, evacuation of building personnel from this specific area is still necessary.

The downtime required for asbestos removal in any isolated space is shorter. However, the overall abatement is greatly extended by partitioning an area into smaller work zones, which translates into greater costs for sprinkler installation as well as the associated asbestos controls.

Partial-floor removal also creates access problems for contractors. Abatement activities must be coordinated with those in the occupied spaces. In addition, the proximity of the work zone to building occupants can cause public/employee relations

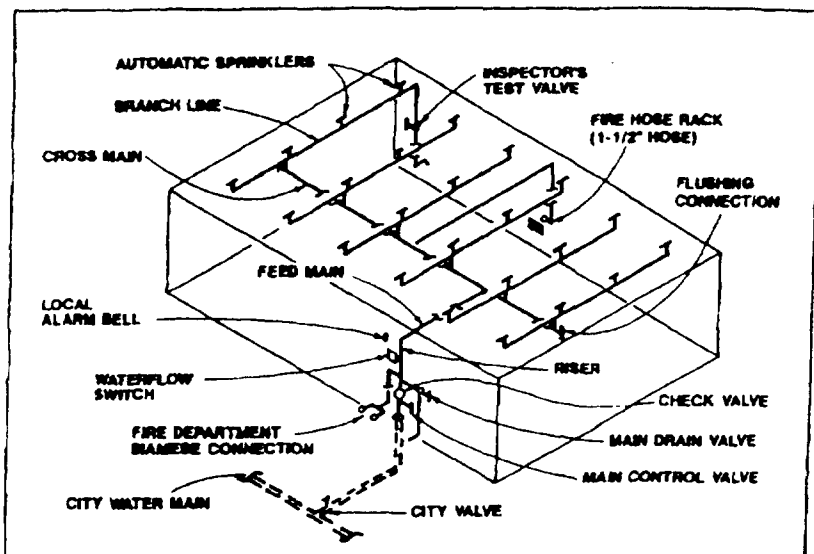


FIGURE 1: Arrangement of elements found in a typical sprinkler system.

problems and a greater potential for liability should a leak occur.

SPRINKLER LOCATION. A high level of coordination is necessary between the sprinkler contractor and the asbestos contractor regarding the exact location of proposed sprinkler

lines. At some point, sprinkler contractors must enter and work in the plenum—with the asbestos materials—for branch-line and sprinkler-head installation.

Tradesmen are often reluctant to

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get involved in a potentially hazardous situation. Some mechanical contractors either disregard or are unaware of the monitoring, personnel protection, employee education, medical examination and record-keeping requirements stipulated in the OSHA asbestos construction standard.

This creates a record-keeping problem as regards the building's operation and maintenance plan. Thorough documentation of confirmed carcinogens in a building requires compilation of accurate drawings depicting the building's existing condition, and is essential in tort liability matters. Although time-consuming, making and maintaining accurate descriptions of the location and condition of ACM is necessary.

DUST CONTROLS. A third option is to remove the entire ceiling and allow sprinkler installation in an enclosed area using simpler isolation and containment techniques than necessary for full asbestos removal. In the case of enclosed dust containment, the asbestos will ultimately remain.

Personal protection for the trades-

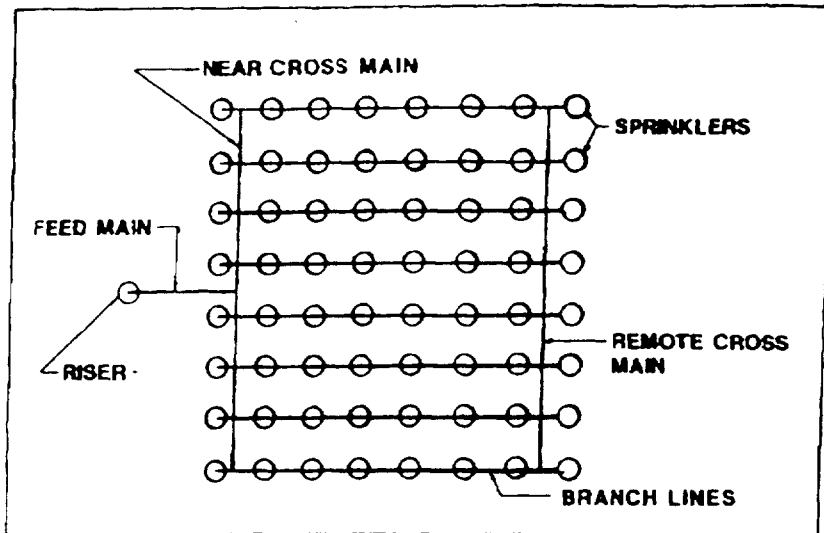


FIGURE 2 The grid layout is chosen by many due to economy of installation

men will still be necessary; occupants must still be evacuated; and other OSHA asbestos requirements must still be met, since airborne fiber exposure is inevitable. Even in a dust-control situation, airtight partitions, isolation of HVAC and negative pres-

sure measures within a large confined area should be instituted.

In this situation, the isolation and preparation phases of the work, which represent a considerable part of the cost of asbestos removal, still have to be done. In a full-floor dust control

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project, such expenditure does not result in the removal of any asbestos. Coupled with the costs of ceiling reinstallation, these costs cause many owners to integrate asbestos removal with other planned renovations.

SPOT REMOVAL. Asbestos removal may be conducted in less time using local isolation techniques for specific locations of sprinkler attachments. This must be done in times of building inactivity—evenings and weekends—to accommodate the occupants of the space. Compressing time schedules results in increased labor costs due to shift differential and/or overtime.

Required environmental controls include covering horizontal surfaces and draping the immediate area with polyethylene sheathing to effect a localized—100 square feet—easily constructed and dismantled isolation. Within this containment, which may also be a portable "mini-cube" of a commercial variety, workers must be protected with respirators and disposable white suits once the ceiling is opened.

Local cleaning within the enclosure should be done by HEPA vacuuming

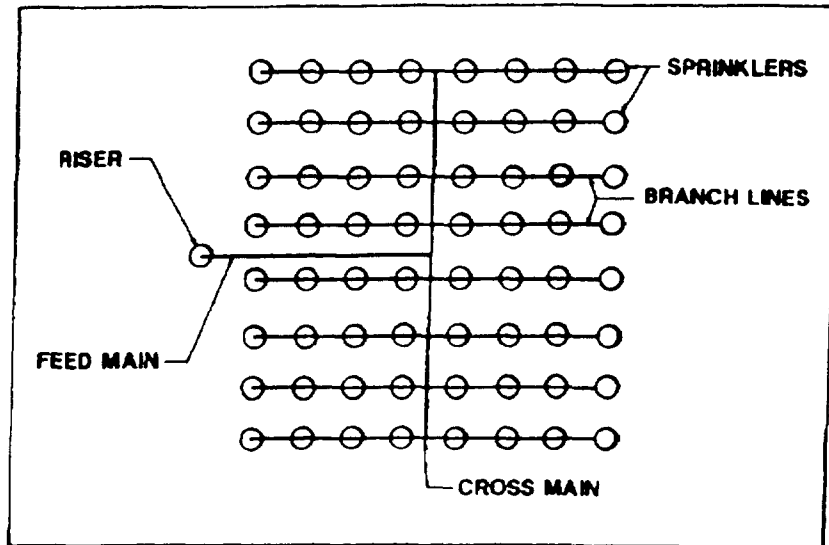


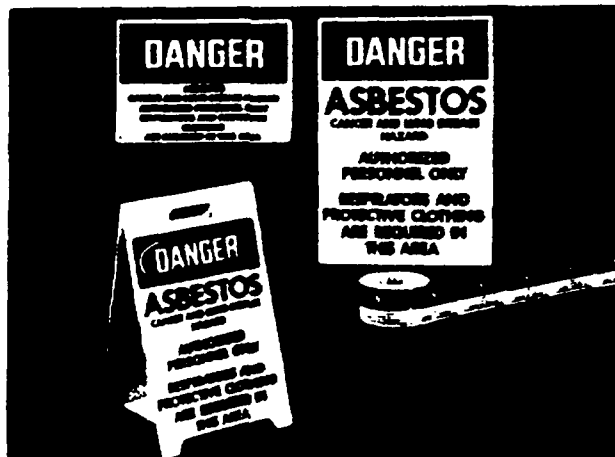
FIGURE 3. The traditional tree configuration of sprinkler layout.

and/or wet-wiping, after which the temporary enclosure should be taken down and the immediate vicinity HEPA vacuumed. Several of these isolated work areas may be installed and operated during a work shift. However, the space must be turned over to

the general population before each work day, and monitoring the work requires daily clearance via air sampling before the building occupants can be allowed back into the space.

A laboratory microscope must be

continued on page 48



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SPRINKLERS

(Continued from page 47)

available on-site since this method involves a long-term, multiphased, after-hours operation, requiring daily assurance that the air quality in the occupied space is acceptable. Additional costs for this work result from working around office furnishings and a contingency in a contractor's price for possible damage resulting from this work.

CHOICE FACTORS. The choice between spot removal with local, temporary isolation and long-term isolation of an entire area via airtight barriers depends on the degree of asbestos disturbance involved. There is a limit to how much spot removal can occur before a more secure total enclosure is appropriate.

This decision is also influenced by completion time-constraints, economics and the work practices of the tradesmen. Careful monitoring by quality assurance inspections and air sampling is required to document acceptable air quality for general build-

ing personnel. The cost of these services will generally be at a premium in this situation due to the need for immediate sample results.

Although asbestos concerns everyone, it should not be regarded as an insurmountable hurdle. With proper

management and careful planning, it is possible to work around asbestos and minimize risks. Installing a sprinkler system can be a smooth and cost-effective operation. ■

References available upon request.

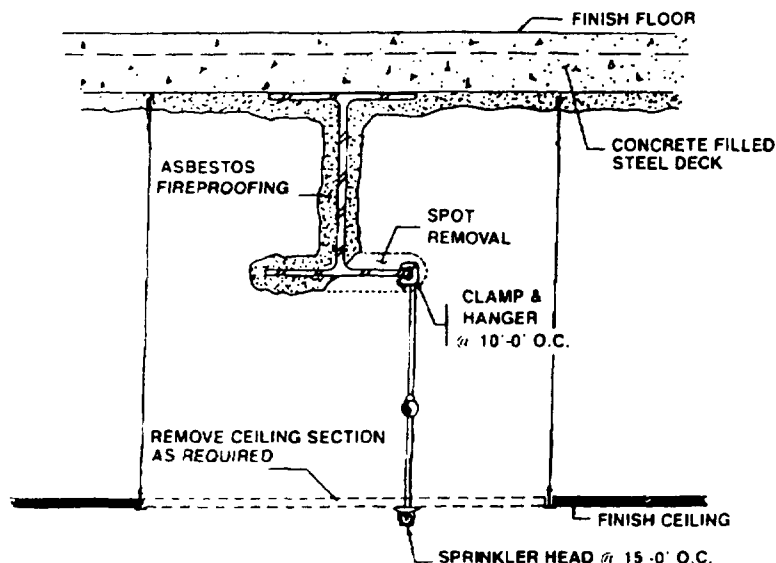


FIGURE 1. Section of typical sprinkler installation.

Asbestos Removal.

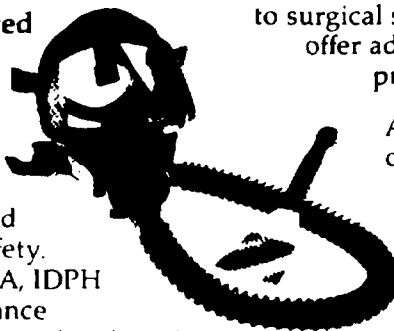
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