



505 A McKnight Park Drive
Pittsburgh, Pennsylvania 15237
Phone: (412) 367-2808
Fax: (412) 367-7193
www.tingwall.com

STORY ABOUT TINGWALL SOLVING THE MOLD PROBLEM

By Raymond Ting

An article entitled "Mold Lawsuits Have Industry Feeling Vulnerable as Larger Projects Are Eyed" by William Krizan with William Angelo and Janice Tuchman published in the 3/31/03 issue of Engineering News-Record. This article highlighted the significant liability exposure of building contractors and designers.

The well-known term of "Sick Air Building" is the result of toxic molds growing inside the building and spreading into the interior air through the air conditioning system. To prevent the problem, it is essential to understand the following two conditions necessary to cause the growing of molds.

1. Wetting of Moisture Absorbing Building Material or Wetting in an Entrapped Area: Typical examples of wetting locations are roof or wall insulating material, inter-floor fire safing material, floor carpet, and space behind or under equipment or furniture.

2. Long Term Wetted Condition : If the wetted material or area can be dried out quickly, there will be no chance for the molds to grow.

WATER PROBLEMS

The typical sources of water causing the wetting problem include the following items.

- (1). Interior Water Condensation : Typical examples are thru-thermal-conductivity of metal components in the roof or the curtain wall system and poorly insulated air cooling pipe or duct.
- (2). Leaking Pipe in the Interior Water Supply or Drainage System.
- (3). Water Infiltration Through the Roof System.
- (4). Water Infiltration Through the Curtain Wall System.

To evaluate the liability exposure of the potential "Sick Air Building" problem, the following questions must be answered.

1. What does it take to prevent the problem ?
2. Is early detection of the problem possible ?



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3. What does it take to remedy the problem ?

4. What is the chance of recurrence of the problem after remedial work ?

It can be readily understood that Problems (1) and (2) have the least liability exposure. Except the skylight area and roof penetrations, the roof water infiltration problem has been largely solved by using standing seam roof system or membrane roof system with good erection practice. The leakage through a skylight area normally results in a well vented open area allowing quick manual or natural drying, therefore, there is little potential for growing molds. Based on the above discussions, Problem (3) has a higher liability exposure than Problems (1) and (2). Problem (4) has the highest liability exposure due to the huge surface area, the aesthetical requirement, the vision area, the mixture of various facing material, the infinite variables of architectural shaping, and the effects of various structural displacements of the building. This paper is intended to identify the causes of Problem (4) leading to the establishment of curtain wall design parameters for minimizing the liability exposure of "Sick Air Building".

CAUSES OF MOLD PROBLEM DUE TO CURTAIN WALL WATER LEAKAGE

It is well known in the industry that water infiltration through a curtain wall will occur when three elements, namely, water on the wall due to rain, positive exterior air pressure due to wind, and imperfect wall joint seal, exist simultaneously at one location. If any one of the three elements can be eliminated at the location, water will not infiltrate through the curtain wall. The conventional method of preventing water leakage is trying to make perfect seal in the wall joints. This would require long lasting sealant material property and perfect workmanship in installing the sealant lines. Due to the extreme total length of wall joints in a building and the impossibility of visual judgment of perfection of the sealant line, the execution of perfect seals throughout the building is deemed to be nearly impossible for a newly erected building. Even if perfect seals are assumed to be possible, sealant material aging effect due to sun exposure and sealant stress cycles due to various forms of structural displacements will cause the eventual sealant functional



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failure. Therefore, the perfect seal concept can not be relied on for prevention of curtain wall water leakage.

The initial stage of water leakage through a curtain wall is practically undetectable. The infiltrated water will normally be trapped within the wall cavities and in more severe cases will cause the wetting of the insulating material and/or the fire safing material behind the curtain wall. This condition can be unnoticeable for a long time since it is normally hidden behind the interior wall board and/or above the ceiling. The space within the wall cavity and the space for the insulation or the fire safing are normally largely closed area which does not allow the trapped water to evaporate easily setting the environment of mold growing. Due to the difficulty of preventing curtain wall water leakage and the nature of undetectable condition for mold growing, water leakage through a curtain wall poses the greatest liability exposure for "Sick Air Building".

CURTAIN WALL DESIGN PARAMETERS FOR MINIMIZING MOLD PROBLEM

Based on the above discussions, the following three curtain wall design objectives must be considered in order to minimize the liability exposure due to the mold problem.

1. To Minimize the Possibility of Water Leakage : The water leakage problem must be solved by design rather than by material (i.e. perfect seal). Since there are only three elements in the water leakage theory, to accept the existence of imperfect seal, the design should try to maximize the separation of the water seal function and the air seal function. The water seal is located along the exterior water path and is air pressure equalized to the exterior behind the seal. The air seal is located at a location beyond the exterior water path. Ideally, if the water seals can be completely separated from the air seals anywhere in the system, then, the system would be free from the perfect seal requirement for water-tightness performance. This ideal condition is accomplished by using TingWall.
2. To Minimize the Sealant Stress due to Structural Movements : This is to ensure the long term performance of the sealant lines. The conventional design concept is to use stronger sealant material to resist the sealant stress. However, repeated stress cycles even



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with adequate safety factor often lead to sealant failure due to stress fatigue. The best way is to free up the degree of fixity within the curtain components to allow low stress or stress free relative movements of the curtain wall components as explained below.

(1). Thermal Movements : It is desirable to use open joint design throughout the curtain wall system. The ideal condition is to have each facing panel individually framed with free space between the adjacent panel frames. In this ideal condition, thermal movements will not produce any significant sealant stress. This ideal condition is accomplished by using TingWall.

(2). Wind Load Effect : In a conventional curtain wall system, the sealant lines around a facing panel are fixed to the panel supporting mullions and girts. The wind load deflection of the facing panel will create a force to pull the sealant lines away from the supports. Repeated load cycles often cause sealant line failure. The ideal condition is to separate the facing panel frame from the supporting frame such that the panel frame can partially flexes with the facing panel deflection to significantly reduce the sealant line stress. This ideal condition is accomplished by using TingWall.

(3). Story Drift due to Wind or Earthquake : The curtain wall supports must undergo the relative side sway displacement caused by the story drift of the building frame. The modern building frame design requires a rather large story drift. This often causes a big problem for the curtain wall design. The ideal condition is to design the curtain wall system to allow the story drift to be absorbed by relative individual facing panel drifts to render the sealant line stress to become insignificant. This ideal condition is accomplished by using TingWall.

(4). Effect of Inter-Floor Deflection : In the conventional curtain wall system, the curtain wall joint must be designed to absorb the total amount of the design inter-floor deflection which is commonly about 3/4". When the curtain wall joint is designed to absorb this amount of large stationary deflection, it is very difficult to maintain the sealing function. The ideal condition is to design the mullion anchoring system to limit the curtain wall joint movement to a much lesser amount (e.g. 1/4") while the inter-floor deflection



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reaches the higher amount (e.g. 3/4"). This ideal condition is accomplished by using TingWall. .

3. To Minimize the Retention of Water in the Curtain Wall Cavities : The ideal condition is to design the system with instantaneous drainage mechanism and fully vented wall cavities. This ideal condition is accomplished by using TingWall.

ACTUAL BUILDING EXAMPLE

The IBM manufacturing plant in Rochester, Minnesota became a Sick Air Building since around 1995. The problem persisted despite many remedial attempts with reported annual maintenance cost of about \$300,000. Upon successful laboratory test performance, IBM awarded the renovation project in 2000 exclusively using TingWall. The total curtain wall area is estimated to be around 880,000 square feet. The project has been proceeded in phases. Up to date, three phases have been completed with complete satisfaction of the owner and the total elimination of the mold problem in the renovated area. The design for the fourth phase has been completed as of 4/25/03.