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Date: June 15, 2005

To: Sample

From: Ed Carroll
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Re: *Design Review of Sample Building Hotel / Residential Tower*

NOTE: This report was completed by mSolve, LLC for insurance risk assessment purposes only. It should not be relied upon for any other purpose. The information contained within the report is not intended to supercede the responsibility of the project’s owners, architect, general contractor or subcontractors on the project. Any mSolve building practice recommendation – intended to minimize the risk for moisture intrusion or accumulation in the buildings – must be reviewed by the owner, architect, general contractor and subcontractor.

1.00 Design Review Summary and Overall Risk Assessment

The purpose of this report is to provide mSolve’s opinion regarding the risk for a substantial moisture or mold problem to develop in Sample Building Venture ’s Sample Building hotel / residential condominium tower planned for construction at

The opinion is based on our review of thedrawings and specifications provided. Specifications were included in Project Manual dated. mSolve conducted a follow up phone call with Sample Building staff memberson June 1, 2005 for clarification and to understand the stage of development.

Based on our experience and an ongoing review of industry information regarding moisture-related building failures, mSolve reviewed these drawings and specification to understand the building’s potential to develop a substantial mold problem based on: 1) how Sample Building plans to direct the general contractor (GC) to control water during construction, 2) building envelope issues, and 3) mechanical system issues.





1.10 Overall Risk Assessment

The project presents a managed risk with respect to moisture intrusion / accumulation. The building envelope and mechanical systems are appropriate for the mixed-humid climate and the construction details reviewed do not present any immediate risk for a moisture intrusion / accumulation problem. The mechanical design specifications are thorough, and provide good capability to pressurize the building and deliver tempered, dry outdoor air.

As discussed below, some important building envelope water management details are being decided at the time of this report given that the GC is currently developing the Guaranteed Maximum Price plans. These details include: a) extent of sealing completed at precast concrete panel joints, and b) what precast panel drainage or guttering system will be selected. When available, Sample Building Venture has agreed to provide shop drawings for the concrete precast panel sections which address these two issues.

Sample Buildinghas included mSolve's recommendations for a construction water management control plan -- as outlined in Attachment A -- in its agreement with the GC selected for the project. Sample Buildinghas agreed to inform mSolve if these provisions are acceptable to the GC.

A third-party envelope consultant will oversee waterproofing details associated with the foundation, exterior walls (precast concrete and punched window elevations) and roof. A curtain wall consultant will be utilized to oversee performance details associated with the glazed aluminum curtain wall system.

If a policy is bound on this project, mSolve will ask to coordinate with Sample Building Venture and the GC for multiple construction site visits to review how the large moisture risks are being addressed given the building type and climate.

2.00 Building Design and Intended Use

The project includes two structures: astory office tower, and astory hotel/condominium tower. Insurance is sought on only the hotel/condominium sections of the project, and therefore mSolve's design review focused only on thestory tower.

Three levels of underground parking span the footprint of the towers, with more limited parking up through the 3rd floor. Floor three includes a swimming pool, and provisions for what will be finished as either a spa or health club. The fourth





floor podium level includes a plaza deck spanning the garage and a small portion of the 3rd floor hotel lobby.

The hotel/condo tower will be constructed with a post tensioned concrete floor system clad with a mixture of aluminum glass curtain walls and precast concrete panels and punched windows.

3.00 Managing Water/Moisture during Construction

Plans for managing water risks during construction are acceptable. The specifications include some clear provisions for responding to leaks during construction; for example Section 09260 – 19 of the Project Manual “Wet, Molded Materials...” requires removal and replacement of any gypsum board that gets wet during construction. Based on the phone conversation with Sample Building Venture staff, mSolve understands recommendations found in Attachment A to this report are being included as a requirement of the GC’s contract.

Sample Building has agreed to inform mSolve if the GC has an issue with complying with the water management protocols listed in Attachment A.

4.00 Building Envelope

This section summarizes our understanding how larger building envelope risks are being addressed.

4.20 Exterior Wall Construction – General Issues

The limited sections of steel framed exterior walls include an internal, foil faced vapor barrier, which can serve to limit drying to the interior of the building. This risk will be managed by a detailed joint sealing at the precast panels, in conjunction with a positively pressurized building.

4.30 Exterior Cladding / Flashing Issues

Exterior wall construction varies by elevation. The north / west elevations include a glazed aluminum curtain wall system with metal panels at the spandrels and penthouse level. The south/east elevations include precast concrete panels with punched windows. The design also includes limited sections of stone



vener and exterior insulation finish (EIFS) at base of the building and penthouse mechanical levels.

North/West Elevation – at the time of this report the GC is preparing bids and selecting a subcontractor for the glazed aluminum curtain wall system. Detailed shop drawings including provisions for venting, weeps, and condensate removal are not yet available. At this point, mSolve is comfortable the water management risks associated with this system will be addressed given the performance based criteria for water and air leakage, and sealant compatibility/adhesion outlined in the Project Manual (Sections 01452, 01454, 08920). Sample Building will contract with a third party curtain wall specialist on design and performance issues.

South/East Elevation – the GC is also preparing bids and selecting a subcontractor for the precast sections of the building. Precast wall sections will also be tested. As noted above, mSolve wants to understand how the final design addresses a) air and rain water penetration at the panel joints, and b) drainage. We understand that the condensate gutter system shown on Sheet A0.05 / MF18 is an option, which may not be selected.

A third-party envelope consultant will provide input on the final design, and a two-stage sealant joint (e.g. similar to the design intent outlined in Figure 1 below is being considered) is being considered. The current drawings (e.g. shown in Figure 2 below) show only a single sealant/backer rod application.

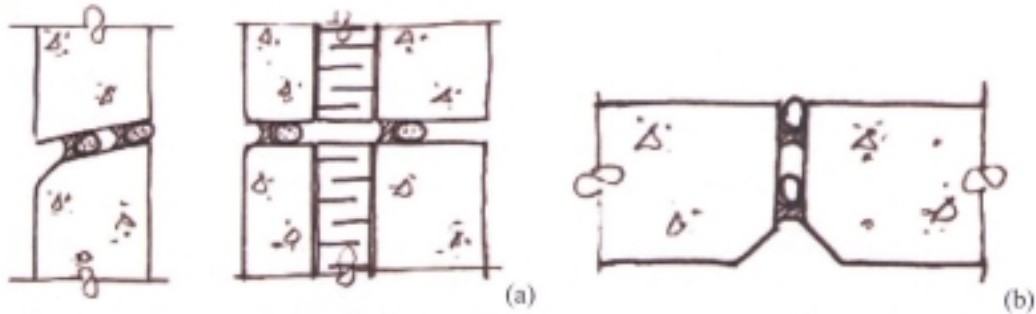


Figure 1a: Typical Two-Stage (Rainscreen) Horizontal Joints

Figure 1b: Typical Two-Stage (Rainscreen) Vertical Joint

Figure 1 – Example of two-stage joint at precast panels. From: “CHMC’s Best Practice Guide – Architectural Precast Concrete Walls – Overview”

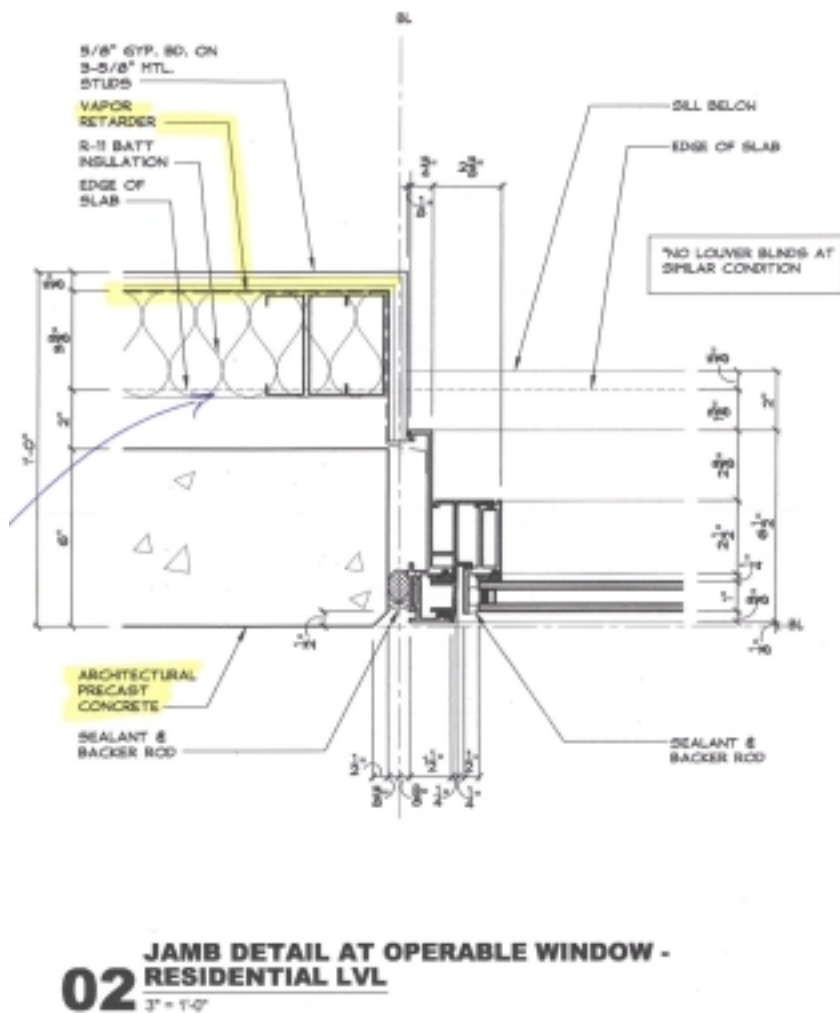


Figure 2 – Window to Precast Panel Jamb Detail from Sheet A6.02/02. One line of sealant and backer rod is currently called out in the drawings

4.40 Exterior Air Sealing Issues

The north/east elevation curtain wall assembly, combined with the fire safing insulation required at slab spandrels, will serve as an effective air barrier.

The air barrier at the south/west elevation is not clearly defined in the current drawings. Similar to the discussion in 4.30 above, two lines of defense at the precast panel joints can work to control air leakage. Without the two lines of



sealant, the design relies on the integrity of the punch windows and interior gypsum to control air leakage.

Given the stage of shop drawing development, and involvement of Sample Associates, mSolve is comfortable that air leakage through the precast envelope will be addressed. Identical to the issues addressed above, we request a copy of the final shop drawings that show how air leakage will be controlled on the precast members.

5.00 Mechanical Issues

The heating, cooling and ventilation for the hotel portion of the building and the residential condominium section are discussed individually below. The mechanical review focused on the following areas:

- Humidity control of outdoor air introduced into the building
- Condensate control of all outdoor air supply and air handling units
- Air balancing
- Insulation
- Procedures related to the control of mechanical system and alarming in cases when moisture and/or water may have a negative impact on building operations

5.10 Hotel Areas: Floors 1 - 12

Humidity Control of Outdoor Air

The common areas of the hotel will be supplied with 10,800 standard cubic feet per minute (scfm) of outside air by three (3) outdoor air supply units designated as OAHU HU 1-3. The air is supplied through 19 vertical duct risers that are insulated with 1 # to 2# density, fiberglass duct liner or equivalent R value, exterior fiberglass insulation. The air supply systems are located on the 2nd floor within enclosed air handling spaces. Each unit is designed to meet or exceed the 2000 International Energy Conservation Code, 803. Meeting or exceeding this section of the code also eliminated the requirement that an economizer system be incorporated into the HVAC system.

Each air handler is specifically equipped to handle dehumidification of the outdoor air based on an ASHRAE 0.4% design condition of 93 F dry bulb and 75 F wet bulb. The building management system is designed to maintain temperature +/- 1 degree F. and alarming will be installed on each unit if temperature and/or desired humidity levels are exceeded.





The outdoor air units will be equipped with auxiliary drain pans and condensate pumps. Each pan is constructed of 304 stainless steel and sloped to prevent standing water by moving water towards the condensate drains. Each drain pan is insulated to prevent condensation on the outside of the pan and each pan is equipped with a water detector interlocked with the air handling unit and the building automation system. When excess water is detected, the air handling unit is shut down and an alarm is sent through the building management system.

Humidity control of the outdoor air will be achieved through mechanical cooling using a DX evaporator coil followed by a reheat coil which will be placed in close proximity to the evaporator coil to prevent re-evaporation of any water.

The Project Manual specifically addresses the issue of condensate blow through which is not allowed. The outdoor air and other air handling units have been sized and equipped with coils that will limit the blow through of condensate into the supply air duct.

Condensate Control

As previously noted all of the outdoor air supply units and air handling units are equipped with insulated, condensate drain pans and collection systems. Most importantly these units are also equipped with water detection systems, designed to prevent potential water damage and shut down system operation until the condensate issue is corrected.

The other area of condensate management relates to the removal of condensate from each of the heat pump, air handling units within thehotel units. As condensate flows off the DX evaporator coil in each unit, the water will flow to a condensate pan below the evaporator coil and into a 1 1/4" condensate drain line which flows into a common condensate collection, piping system.

If the air filters in the heat pumps are not properly maintained or are removed there is the potential that debris may collect on the evaporator coil. This debris could be removed by the condensate that forms on the coil and be washed into the condensate collection system where it could clog the condensate drain.

To address this risk (lack of automated control or alarming) mSolve recommends a regular inspection (every 12 months) of the condensate removal systems in each hotel unit. Any moisture problems that are observed should be documented and repaired immediately.





Air Balancing: Hotel Floors 5 – 12

Based on a review of the mechanical drawings it appears that the hotel room portion of the building will maintain a positive pressure. A summary of air supply and exhausts is provided below. The air supplied to pressurize the two stairwells is not included since it is a separate system isolated from the remainder of the building.

Air Supply/Exhaust Component	SCFM
Outdoor Air Supply	10,800
Toilet Exhausts	(8,400)
Net Air Balance	2,400

Air Balancing: Hotel Floors 1 - 4

Based on a review of the mechanical drawings it appears that the common areas of the hotel (floors 1-4) will maintain a positive pressure. A summary of air supply and exhausts is provided below. The air supplied to pressurize the two stairwells is not included since it is a separate system isolated from the remainder of the building.

Air Supply/ Exhaust Component	SCFM
Supply Air Including Outdoor Ventilation	47,800
Exhaust Air	18,200
Net Air Balance	29,600

Air Balancing: Pool Area

The pool area is located on the 3rd level of the hotel and is supplied with 4,000 SCFM of air from air handler AHU 3-1. Since the pool represents a primary source of moisture in the building it is important that the pool area be well enclosed and that a slightly negative air pressure is maintained. The negative air pressure will decrease the migration of saturated pool air from the pool area to hotel corridors or into the building structure itself.

From a review of Volume 3 and Addendum 1 of the work plan, 1,500 SCFM of pool exhaust is clearly identified as EF 5R-2. On the drawings another exhaust fan is shown located directly below the supply air duct to the pool area. Based on the grille size for this exhaust it may be capable of exhausting approximately 3,500 scfm of air. If this is the case then the pool area is designed to maintain a slightly negative pressure of $4,000 - 5,000 = -1,000$ scfm.





However, the design volume of the second exhaust could not be verified. It is therefore recommended that all supply and exhaust volumes be verified and balanced so a negative pressure in the pool area is maintained. Additionally, work practices should be developed to ensure that door entrances to the pool area are kept closed except when in use. Also the use of pool covers to limit pool evaporation should be considered for all unoccupied periods. Pool covers will significantly reduce the evaporation of water into the air and reduce energy costs and pool chemical use.

Insulation

Many components of the building's mechanical system that may impact moisture levels will be well insulated in order to prevent condensation and reduce heat/cooling energy losses. Specific components that will be insulated include:

System Component	Insulation
Outdoor Air Supply Units	1" Solid Foam (R=5)
Air Handlers	1.5 # density insulation treated with EPA registered anti-microbial agent
Condenser Water Supply and Return Piping	1" Fiberglass Insulation
Refrigeration Piping	3/4" Closed Cell Insulation
Duct Work	Fiberglass Duct Liner (2# density) treated with EPA registered anti-microbial agent.
Domestic Cold and Hot Water	1/2 " Fiberglass Insulation

It should be noted that in addition to duct linter, all duct work joints, seams and connections will be sealed with an approved sealant that has an NFPA, ASTM and UL flame spread and smoke hazard that does not exceed a flame spread of 25 and a smoke developed rating of 50.

Procedures as Specified in the Work Manual

The specifications are thorough, addressing the issues related to the introduction and control of moisture into the space via the building's mechanical systems. Many of the main issues related to construction and system operation have been properly addressed.

The only additional information that should be considered is an operating procedure to deal with future moisture issues. The procedure should include a work plan for the quick and efficient removal of any excess moisture that may occur in common areas or hotel rooms. The procedure should also address the regular inspection of potential problem areas especially hotel heat pumps, air





handling unit condensate drains, and potential condensate carryover from air handling units into downstream duct work.

5.20 Condominium Area: Floors 13 - 29

Humidity Control of Outdoor Air

The common areas of the condominium units will be supplied with 28,350 standard cubic feet per minute (scfm) of outside air from four (4) outdoor air supply units designated as OAHU PH 1-4. The air is supplied through 17 vertical insulated duct risers. The air supply systems themselves are located on the roof within a penthouse structure. Each unit is designed to meet or exceed the 2000 International Energy Conservation Code, 803. Meeting or exceeding this section of the code also eliminated the requirement that an economizer system be incorporated into the HVAC system.

Each air handler is specifically equipped to handle dehumidification of the outdoor air based on an ASHRAE 0.4% design condition of 93 F dry bulb and 75 F wet bulb. The building management system is designed to maintain temperature +/- 1 degree F and alarming will be installed on each unit if temperature and/or desired humidity levels are exceeded.

The outdoor air units will be equipped with auxiliary drain pans and condensate pumps. Each pan is constructed of 304 stainless steel and sloped to prevent standing water by moving water towards the condensate drains. Each drain pan is insulated to prevent condensation on the outside of the pan and each pan is equipped with a water detector which is interlocked with air handling unit and the building automation system. When excess water is detected, the air handling unit is shut down and an alarm is sent through the building management system.

Humidity control of the outdoor air will be achieved through mechanical cooling using a DX evaporator coil followed by a reheat coil which will be placed in close proximity to the evaporator coil to prevent re-evaporation of any water.

The Project Manual specifically addresses the issue of condensate blow through which is not allowed. It appears that the outdoor air and other air handling units have been sized and equipped with coils that will limit the blow through of condensate into the supply air duct.

Condensate Control

As previously noted all of the outdoor air supply units and air handling units are equipped with insulated, condensate drain pan and collection systems. Most





importantly these units are also equipped with water detection system, designed to prevent potential water damage and shut down system operation until the condensate issue is corrected.

The other area of condensate management relates to the removal of condensate from each of the air handling units within the 135 condominium units. The units are designed that as condensate flows off of the DX evaporator coil in each unit it flows to a condensate pan below the evaporator coil and then into a 1” condensate drain line which flows into a common condensate collection, piping system.

If the air filters in the air handlers are not properly maintained or are removed there is the potential that debris may collect on the evaporator coil. This debris could be removed by the condensate that forms on the coil and be washed into the condensate collection system where it could clog the condensate drain. The Project Manual specifically states on page 36, Section 15900 – 93 that the individual condo units will not be connected to the building automation system for alarming of condensate overflow.

Based on the lack of automated control or alarming it is recommended that HKS design a work process to ensure regular inspection of the condensate removal systems in each condo unit. This inspection should be performed on an annual basis. Any moisture problems that are observed should be documented and repaired immediately.

Air Balancing of the Condominium Space

Based on a review of the mechanical drawings it appears that the building will maintain a positive pressure. A summary of air supply and exhausts is provided below. The air supplied to pressurize the two stairwells is not included since it is a separate system isolated from the remainder of the building.

Air Supply Component	SCFM
Outdoor Air Supply	28,350
Toilet Exhausts	(14,500)
Range Exhausts (@100% Utilization)	(6,400)
Net Air Balance	7,450

Insulation

Many components of the building’s mechanical system that may impact moisture levels will be well insulated in order to prevent condensation and reduce heat/cooling energy losses. Specific components that will be insulated include:





System Component	Insulation
Outdoor Air Supply Units	1" Solid Foam (R=5)
Air Handlers	1.5 # density insulation treated with EPA registered anti-microbial agent
Condenser Water Supply and Return Piping	1" Fiberglass Insulation
Refrigeration Piping	¾" Closed Cell Insulation
Duct Work	Fiberglass Duct Liner (2# density) treated with EPA registered anti-microbial agent.
Domestic Cold and Hot Water	1/2 " Fiberglass Insulation

It should be noted that in addition to duct linter, all duct work joints, seams and connections will be sealed with an approved sealant that has an NFPA, ASTM and UL flame spread and smoke hazard that does not exceed a flame spread of 25 and a smoke developed rating of 50.

Procedures as Specified in the Work Manual

The specifications are thorough, addressing the issues related to the introduction and control of moisture into the space via the building's mechanical systems. Many of the main issues related to construction and system operation have been properly addressed.

The only additional information that should be considered is an operating procedure to deal with future moisture issues. The procedure should include a work plan for the quick and efficient removal of any excess moisture that may occur in common areas or condos. The procedure should also address the regular inspection of potential problem areas especially condo air handling unit condensate drains, rooftop air handling unit condensate drains and potential condensate carryover from air handling units into downstream duct work.

We appreciate the opportunity to provide our building-science based review of the plans for this project.

