

INDOOR ENVIRONMENTAL QUALITY EVALUATION

**M. GONZALEZ RESIDENCE
475 PRECIOUS, VILLAS AT FORTUNA
SAN ANTONIO, TEXAS**

Prepared for

**SAN ANTONIO HOUSING AUTHORITY
SAN ANTONIO, TEXAS**

by

ETC INFORMATION SERVICES, LLC

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Project No. 7A-020
May 17, 2007

Mr. Timothy Alcott
San Antonio Housing Authority
1315 N. Elmendorf
San Antonio, Texas 78207

**Re: Indoor Environmental Quality Evaluation
M. Gonzalez Residence 475 Precious, San Antonio, Texas**

Dear Mr. Alcott:

A copy of the report for the investigation of the referenced property is being forwarded to you for your information and necessary action. This report is part of a more comprehensive report on ten properties in the Villas at Fortuna, Blueridge, and Sunflower subdivisions. The comprehensive report should be used for a full introduction, discussion of field operations, and discussion.

We will be happy to answer any questions concerning this report. It has been a pleasure working with you on this important assignment. We look forward to being of continuing service to you.

Sincerely,

ETC INFORMATION SERVICES, LLC

Donald J. Schaezler, Ph.D., P.E., CIH
President

1.0 INTRODUCTION AND BACKGROUND

1.1 Purpose of the Evaluation

The subject residence was evaluated for indoor environmental quality conditions April 17, 2007. The purposes of the evaluation were as follows:

- To interview residents about their complaints with respect to water damage, mold, health symptoms, and other indoor environmental issues
- To collect indoor air samples for identification and enumeration of airborne fungal spores and culturable fungi
- To collect indoor air samples for enumeration of fiber glass and other mineral fibers, pollen, skin cell fragments, and other particles
- To measure indoor air quality with respect to common chemical and physical parameters
- To evaluate apparent sources of water damage and visible mold in the residence
- To document areas with excess moisture content in building materials
- To assess, in a preliminary manner, the condition and performance of the HVAC system
- If necessary, to recommend remediation, including preparation of a Mold Remediation Protocol

The investigations were performed at a screening level and were designed to obtain information on the overall condition of the residence. They were not intended to be in-depth investigations of all potential conditions that affect the indoor environment.

The investigations were conducted by Donald J. Schaezler, Ph.D., P.E., CIH, with assistance from other ETC staff. Dr. Schaezler is a licensed Mold Assessment Consultant (MAC), a licensed professional engineer (P.E.), and a Certified Industrial Hygienist (CIH).

1.2 Subject Residence

The subject residence was in the Villas at Fortuna subdivision. The residence was apparently built by KB Homes in about 2000. It has been leased to the Gonzalez family but is owned by SAHA. Over the past several years, the residents in similar homes had complained to SAHA and KB about a variety of structural and indoor environmental issues. These complaints have triggered investigations by several consultants, including this report.

2.0 FIELD OPERATIONS

2.1 Description of Residence

The subject residence is approximately seven years old and is a single-family dwelling located in west San Antonio, between West Commerce and Culebra Road, near St. Mary's University. It appears to have a reinforced concrete foundation, Hardiplank® siding external wall finish, conventional wood framing, and a complex hip and gable roof with composition shingles. It is a two-story structure with five bedrooms, two bathrooms, one half-bath, Kitchen, Dining Room, Living Room, Utility Closet, and an attached one-car Garage. The layout of the subject residence is shown schematically in Figure 4.

The residence had carpeting in the Living Room, the Dining Room, the bedrooms, and the hallways. It had vinyl flooring in the Entry, Kitchen, bathrooms, and the Utility Closet. Interior finishes were typically textured and painted gypsum board.

There is a single, central HVAC system of split design. The condenser unit (CU) is outside on a concrete pad. The air handler unit (AHU) is in a hallway closet near the Hall Bathroom on the second floor. Return air is routed through a grille in the lower closet door and up through a supporting platform to the AHU. The AHU has a return air filter, evaporator coil, blower, and electric heating unit. Supply air is routed up to the Attic through a ductboard plenum. Flexible runouts are attached to that plenum. There are chases for ductwork to reach the first floor ceilings. The return air plenum is shared by a low profile hot water heater, which sits in an overflow pan. The ceiling penetration in the HVAC Closet is sealed with aluminum foil duct tape. There were small openings to a chase behind the AHU and, probably, to the attic behind the supply air plenum.

The Utility Closet included connections for a washer and a dryer. The dryer exhausted to a vent stack located in a wall cavity, and the vent stack continued through the roof.

For simplicity of discussion in this report, Precious is assumed to run north-south. Directional references, such as front, right, rear, and left will refer to an observer facing the front of the house from the street.

2.2 Observations

1. No one was home initially, and the investigation was conducted without the home owner present. Ms. Gonzalez did arrive during the investigation.
2. There was water damage, rotten wood, and mold growth near the back door, including on the tackboard and the base trim.
3. There was minor water staining on several window sills.

4. There was minor water damage on the lower wall and trim near the head of the tub in the Master Bathroom.
5. The carpeting on the second floor was very dirty and in poor condition.
6. The return air plenum had a minor amount of dust.
7. The return air filter was a high efficiency pleated filter. It had a significant buildup of dust.
8. The evaporator coils were very dirty. A large part was covered with debris and dry scum.

Areas with water damage and mold growth are summarized in Table 2, along with other characterizations of investigation results.

2.3 Field Measurements

2.3.1 Moisture Content

Moisture measurements were made for wood, sheetrock, and concrete surfaces in areas with visible or potential water damage with Delmhorst and Tramex moisture instruments. Measurements were also taken in background areas for comparison. Excess moisture was found near the back door.

2.3.2 Air Quality

During the survey, the indoor area was investigated by measuring general indoor air quality parameters to determine the potential for chemical and physical problems. Temperature, relative humidity, carbon dioxide, and carbon monoxide were measured using a Vulcain Safety Palm field instrument. Results are summarized in Table 3. Key points are discussed below.

1. The indoor relative humidity was unsatisfactory.
2. Carbon dioxide values were satisfactory, due to the absence of occupants, initially.
3. Carbon monoxide values were zero.

2.3.3 Thermal performance of Heating, Ventilation, and Air-Conditioning System (HVAC)

During the survey, the thermal performance of the HVAC system was evaluated by measuring temperature of supply air and return air in the system, using a laser-focused infrared thermometer. The Gonzalez residence had good thermal performance. The results are summarized in Table 4.

2.4 Sampling

The emphasis of the sampling program was to evaluate indoor air quality. The blower in the AHU was turned on before sampling. Samples were collected from three locations, at the return air grille, in the Living Room, and in the Master Bedroom near the Master Bathroom.

2.5 Photographs

Photographs of the subject residence are available for review.

3.0 RESULTS AND DISCUSSION

All sample results are included in the comprehensive report. The results are summarized in the tables and are discussed in this section for comparison purposes.

3.1 Fungi in Air

Three sets of indoor air samples and one outdoor air sample was collected for the house. One set of indoor air samples was collected from near the return air grille, one set was collected from the Master Bedroom near the Master Bathroom, and a third was collected from the Living room. Indoor air samples were collected for indirect evidence of water damage and mold amplification and to evaluate potential exposures to occupants of the house.

Outdoor air samples from the neighborhood were used for all houses in that neighborhood on that day.

Samples were collected for total bioaerosols, using Allergenco D cassettes, which are slit impaction samplers. Sampling was at 15 liters per minute for five minutes. The slides in the cassettes were interpreted microscopically by Aerotech and were analyzed for total bioaerosols. Results of analyses are summarized in Table 5.

Samples were also collected for culturable fungi, using a single stage Anderson-type impactor with potato dextrose agar plates. Sampling was at 28.3 liters per minute for three minutes. The plates were then reassembled, sealed with tape, and shipped to Aerotech for incubation and interpretation. Results of analyses are summarized in Table 6.

1. Outdoor air had typical levels of total fungal spores, dominated by Ascospores.
2. Indoor air in the Gonzalez residence had very low levels of total fungal spores, relative to outdoor air, in the Master Bedroom and at the return air upstairs.
3. Indoor air in the Living Room had high levels of total fungal spores, dominated by *Aspergillus/Penicillium*-like spores.
4. Outdoor had typical levels of culturable fungi, dominated by yeast.
5. Indoor air in two locations, at the return air and in the Living Room, had high levels of culturable fungi, dominated by *Aspergillus* and *Penicillium* species.
6. These results indicate that there are likely sources of *Aspergillus* and *Penicillium* growth that are affecting the indoor environment.

3.2 Swab, Bulk, and Dust Samples

Surface samples were taken with sterile swabs. These samples were analyzed by microscopic examination and by culturing. Results of analyses are summarized in Tables 7 and 8.

3.2.1 Evaporator Coil Samples

Evaporator coils are cold during operation of the air-conditioning system, and condensation typically occurs. Dust accumulation typically occurs on coils because of the small dimensions of the finned coils. Dust accumulation is exacerbated if return air filtering is poor. If dust has accumulated on the coils, fungal amplification of cold-tolerant microorganisms may take place. Evaporator coils may then be a source of microbial matter in the indoor environment.

1. The evaporator coils were heavily laden with debris.
2. The coils had low levels of total fungal spores, dominated by Basidiospores. Yeast were also reported.
3. The coils had high levels of culturable fungi, dominated by *Aureobasidium*. High levels of culturable yeast were also present

3.3 Fibers and Other Particles in Air Samples

The Allergenco D slides were evaluated by Aerotech for the presence of fibers and particles of potential interest other than fungal spores and mycelial fragments. The fibers found were compared specifically to attic insulation. The results are summarized in Table 5. Compared to samples collected from other houses, there were low concentrations of fibers in the three samples. There were high levels of skin fragments in two of the three indoor air samples.

3.4 Sources of Water Damage

Based on field observations and measurements, apparent sources of water causing damages at the subject residence include the following:

1. Rain water intrusion at the back door
2. Condensation at windows
3. Dirty evaporator coils

4.0 CONCLUSIONS

1. The Gonzalez residence had excess relative humidity during the preliminary investigation.
2. The house had adequate filtration within the air handler unit (AHU), but the evaporator coils were very dirty, indicating that good filtration has not always been present. Poor filtration will contribute to accumulation of debris on the evaporator coils and contribute to problems with excess dust in the house.
3. The residence had very slight water damage at several window sills. This damage is consistent with condensation that would occur during cold weather.
4. There was significant water damage, mold growth, and rotten wood near the back door.
5. Water intrusion is evident at the back door.
6. The cleanliness of the AHU system was poor. This was especially true for the evaporator coils
7. There were elevated levels of *Aspergillus/Penicillium*-like spores and culturable *Aspergillus*, and *Penicillium* in indoor air samples.
8. There were elevated levels of culturable fungi on the evaporator coils.
9. There were low concentrations of fibers in the three samples. There were high levels of skin fragments in two of the three indoor air samples.
10. The Gonzalez residence should be remediated to eliminate the sources of fungal growth in the residence.

5.0 RECOMMENDATIONS

1. A technically competent HVAC contractor should evaluate the Gonzalez residence for the size of the HVAC equipment, the capacity of the blower, the size of the plenums, the size and orientation of the ductwork, the size of the registers, the connections of all supply air components, the sealing of the HVAC Closet and return air plenum, the cleanliness of the system and the need for cleaning, the thermal performance of the system, the balance of the supply air system, the operation of the thermostat, the level of refrigerant in the system, and other aspects of the design and operation of the system. All deficiencies should be corrected, including cleaning of the evaporator coils outside of the house.
2. The Gonzalez residence should continue to use high performance pleated return air filters, rated as MERV 8 or better.
3. Deficiencies in installation of doors and windows should be corrected as necessary.
4. During the evaluation of the HVAC system and investigation of door and window installations, the Mold Assessment Consultant should evaluate the condition of the system with respect to mold contamination.
5. Because of the visible water damage and mold growth, and the elevated levels of fungi in the indoor air and on the evaporator coils, the Gonzalez residence should be remediated. Remediation may require that the residents move from the house for a period of time. Following remediation, including post remediation verification (clearance), the residents should be able to reoccupy their home.
6. Mold contamination likely affects areas with more than 25 contiguous square feet. Therefore, the mold remediation work must follow the Texas Mold Assessment and Remediation Rules (TMARR). A Mold Remediation Protocol is being prepared for the work recommended above.
7. All penetrations of the ceilings (such as peripheral edges of supply air ducts and vents and exhaust fans) and chases (such as at the HVAC closet) should be sealed.
8. Improperly finished sheetrock/shower-surround junctions should be properly repaired.
9. Following remediation and other repairs, the residence should be thoroughly cleaned. HEPA-vacuuming of all surfaces and HEPA-vacuuming plus hot water extraction of upholstery and carpeting by a professional cleaning company may be very useful to reduce the inventory of dust in the house. Together with use of high performance return air filters, this should help to correct the dust problems. Badly soiled carpet and carpet in poor physical condition should be replaced

TABLE 1 – SUMMARY OF RESIDENCE CHARACTERISTICS

TABLE 1 – SUMMARY OF RESIDENCES INVESTIGATED

No.	Street	Resident	Owner	Yr. Built	SF	Stories	Garage	Floor Plan	Subdivision	Date Investigated
475	Precious	Melissa Gonzalez	SAHA	2000	690(1)/1000(2)	2	1.5-car	IV	Villas at Fortuna	17-Apr

TABLE 2 – SUMMARY OF MOLD GROWTH, WATER DAMAGE AND MOISTURE CONTENT

No.	Street	Resident	Visible Mold Growth	Visible Water Damage	High Moisture Content
475	Precious	Melissa Gonzalez	Back door-base trim, tackboard Master Bathroom lower walls at head of tub (slight)	Back door-base trim, door trim, tackboard, including rot Master Bathroom lower walls at head of tub (slight)	Wet baseboard and tackboard near back door

Yellow-highlighted boxes indicate conditions that may be significant in evaluation of indoor environmental issues.

**Table 3
Summary of Air Quality Measurements**

Location	Temp °F	RH %	CO ₂ Ppmv	CO Ppmv	Dew Point °F
April 17, 2007					
Outside Air	65.1	94	459	0	62.5
Inside Air					
475 Precious (M. Gonzalez) LR	71.5	63	631	0	57.5
475 Precious (M. Gonzalez)RA	70.8	64	669	0	57

Yellow-highlighted boxes indicate conditions that may be significant in evaluation of indoor environmental issues.

TABLE 4 – SUMMARY OF HVAC SYSTEM OPERATION AND SPECIAL CONDITONS

No.	Street	Resident	AC Operation	AHU Cleanliness	Dew Point	IAQ CO ₂ /CO	No. Occupants	Pets	Comments
475	Precious	Melissa Gonzalez	Good	Some dust Much dried scum on coils	57	669/0	Not known	Not known	Upstairs carpets soiled and in poor condition

Yellow-highlighted boxes indicate conditions that may be significant in evaluation of indoor environmental issues.

TABLE 5 – SUMMARY OF AIRBORNE AND AHU PARTICLES

No.	Street	Resident	Sample Location	Total Fungal Spores	Unusual Spore Counts	Mycelial Fragments	Fiber Count	Skin Cell Fragments	Fiber-glass	Pollen	AHU
April 17, 2007											
Outdoor Air Samples – Villas at Fortuna											
452	Precious	Martinez	OA-front	2160	Asc>Bas	<13	133	573	<13	67	
Indoor Air Samples – Villas at Fortuna											
475	Precious	Gonzalez	Return Air	107	Bas	53	560	4,480	<13	40	Coils: Low spores, Bas>Sm
475	Precious	Gonzalez	MBR	93	Bas>As/Pn	13	587	4,853	<13	13	
475	Precious	Gonzalez	LR	3,560	As/Pn>Cl 2,467 As/Pn 933 Cl	67	440	1,560	<13	<13	

Yellow-highlighted boxes indicate conditions that may be significant in evaluation of indoor environmental issues.

Alt denotes *Alternaria*. As/Pn denotes *Aspergillus/Penicillium*-like spores. Asc denotes Ascospores. Bas denotes Basidiospores. Bi denotes *Bipolaris/Drechslera*. Cl denotes *Cladosporium*. Sm denotes Smuts/Myxomycetes/*Periconia*. A>B, C denotes that type A is more numerous than type B, which in turn has the same numbers as type C.

TABLE 6 – SUMMARY OF AIRBORNE CULTURABLE FUNGI AND AHU SAMPLES

No.	Street	Resident	Sample Location	Total Fungi	Distribution Unusual Counts	Return Air Filter	Supply Air Plenum
April 17, 2007							
Outdoor Samples – Villas at Fortuna							
452	Precious	Martinez	OA-front	753	Y>Cl>StH		
Indoor Air Samples – Villa at Fortuna							
475	Precious	Gonzalez	Return Air	1,753	As>Pn>Cl 906 As, 424 Pn, 376 Cl	Coils: high Aur, Yeast	
475	Precious	Gonzalez	MBR	94	Cl>StH		
475	Precious	Gonzalez	LR	3,106	As>Pn>Cl 1941 As, 635 Pn, 518 Cl		

Yellow-highlighted boxes indicate conditions that may be significant in evaluation of indoor environmental issues.

**Table 7
Swab Samples
Identification of Fungal Spores – Major Genera
Method S001**

Ref. No.	Description of Swab Samples	Concentration, Cts/cm ² (%)					
		<i>Alternaria</i>	<i>Aspergillus/ Penicillium-like spores</i>	Basidio-spores	<i>Cladosporium</i>	Total fungal spores	Mycelial Fragments
SB-5-S ¹	Evap Coil, M. Gonzalez	ND	ND	74 (50)	15 (10)	148	89

Yellow-highlighted boxes indicate conditions that may be significant in evaluation of indoor environmental issues.

¹ Yeast observed on swab sample.

Table 8
Swab Samples
Identification of Cultural Fungi – Major Genera
Method S002

Ref. No.	Description of Swab Samples	Concentration, CFU/cm ² (%)						
		<i>Aspergillus</i> species	<i>Aureobasidium</i>	<i>Cladosporium</i>	<i>Penicillium</i> Species	<i>Fusarium</i>	Sterile Hyphae	Total fungi
SB-5-S ¹	Evap Coil, M. Gonzalez		24,800 (83)					29,900

Yellow-highlighted boxes indicate conditions that may be significant in evaluation of indoor environmental issues.

¹ Yeast numbers were also high on the swab sample.

