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– ENGINEERING SPECIFICATION – Project 10-010

INTERIOR FLOORING SPECIFICATION TO CONTROL TRANSMISSION OF IMPACT SOUND THROUGH FLOORS AT ROYALE RIVIERA CONDOMINIUM

935 East Causeway Boulevard , Vero Beach, FL 32963 – Final Rev. March 31, 2010

All unit owners who decide to install tile, wood or other flooring products (other than carpet with padding) must install an acceptable sound control material in order to reduce or isolate impact noises from people walking, dropped objects, furniture being moved, etc..

The Engineer recommends the use of the following sound control products for tile, stone and wood products. While all products are approved; for each application, the products are listed by order of preference. All installations shall be performed according to manufacturer instructions.

Ceramic Tile/Stone (Thin Bed) Installations.

1.) "QTscu 4005" by Ecore International; 3/16-inch (5 mm) thick rubber-based sound control underlayment.
2.) "Cerazorb" by Impacta; 3/16-inch (5 mm) thick synthetic cork underlayment.

Laminate/Solid Wood/Bamboo Installations.

1.) "SolidBlack-MD-TPO" by Pak-Lite, Inc.; 0.08-inch (2 mm) thick polyolefin foam and polyethylene film underlayment.
2.) "Royal Walk 2MM" by Simple Floors; 0.08-inch (2 mm) thick polyolefin foam underlayment.
3.) "FootFall" by All Noise Control; 0.125-inch (3.2 mm) thick rubber-based floor underlayment.

Prior approval to install tile, stone, laminate, solid wood, bamboo or other flooring products in a unit must be obtained from the Board of Directors. Requests should be submitted in writing to the President of the Association.

For more specific information regarding these specifications please see Hans Heinz Kowalski's, Engineer's "Specifications to Control Transmission of Impact Sound Through Floors at Royale Riviera Condominium, Vero Beach, Indian River County, Florida, Rev. 2, Final" dated March 31, 2010.

Prepared by: Hans Heinz Kowalski P.E., FL PE 59388

March 31, 2010

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March 31, 2010

Royale Riviera Condominium
Attn.: Mr. Burtram Anderson
935 East Causeway Boulevard, Apt. 507
Vero Beach, FL 32963
Phone: (716) 745-3648

Project: 10-010

Reference: **ENGINEER'S SPECIFICATION TO CONTROL TRANSMISSION OF IMPACT SOUND THROUGH FLOORS AT ROYALE RIVIERA CONDOMINIUM, VERO BEACH, INDIAN RIVER COUNTY, FLORIDA. - Rev. 2, Final**

Dear Mr. Anderson:

In accordance with the request of the Royale Riviera Condominium Board, the Engineer has prepared the following report letter and specification to be used by unit owners in order to install tile, wood, or other flooring products over the concrete floor in all areas of the apartment, other than carpet and pad in the living areas or bedrooms.

There are two basic types of noise in buildings and two corresponding measurements used to rate the acoustical performance of the floor-ceiling assembly. They are airborne noise and structure-borne noise. The single-figure ratings used to determine the acoustical performance of assemblies with respect to airborne and structure-borne noise are the Sound Transmission Class (STC) and the Impact Insulation Class (IIC) respectively.

- The STC measures the performance of the floor-ceiling assembly to stop or isolate airborne noise such as voices, barking dogs, stereos, televisions, etc.

- The IIC measures the performance of the floor-ceiling assembly to reduce or isolate impact noises from people walking, dropped objects, furniture being moved, etc.

The Florida Building Code (FBC) has established in Building Section 1207 standards for minimum required noise performance of structural assemblies between residences.

Section 1207.2: "Air-borne sound" states that "Walls, partitions and floor/ceiling assemblies separating dwelling units from each other or from public or service areas shall have a sound transmission class (STC) of not less than 50 (45 if field tested) for air-borne noise when tested in accordance with ASTM E 90." (Next part of Section is not shown.)

Section 1207.3: "Structure-borne sound" states that "Floor/ceiling assemblies between dwelling units or between a dwelling unit and a public or service area within the structure shall have an impact insulation class (IIC) rating of not less than 50 (45 if field tested) when tested in accordance with ASTM E 492."

The floor-ceiling assemblies separating the Royale Riviera building apartment units are composed of 8 inch-thick 'Hollowcore' concrete planks covered with a 2 inch-thick lightweight concrete topping.

Based on Table 7.4.1: "Airborne sound transmission and impact insulation class ratings from laboratory tests of hollow core slab floor-ceiling assemblies" of Chapter 7: "Acoustical Properties of Hollowcore Floor Slabs" of the Precast/Prestressed Concrete Institute (PCI) Manual for the Design of Hollowcore Slabs, 2nd Ed. 1998; the assemblies listed below have the following STC and IIC ratings.

Assembly	STC	IIC
8 in. hollowcore (hc) slab	50	28
8 in. hc slab w/ carpet & pad	50	73
8 in. hc slab w/ 1.5 in. concrete topping w/ carpet & pad	50	76
8 in. hc slab w/ 0.5 in. adhered wood flooring	51	47
8 in. hc slab w/ 1.5 in. concrete topping w/ 0.5 in. wood flooring on adhered sound-deadening board	51	53

From the assemblies listed above it can be deduced that airborne sound transmission varies very little whereas impact noise insulation varies greatly, depending upon the floor covering. Also, note that all assemblies pass the code STC minimum of 50 whereas two of the listed assemblies do not pass the code IIC minimum.

Also it is seen that a carpet and pad provides the best impact insulation and contributes 45 IIC rating units to the assembly. Similarly, 0.5 inch-thick wood block flooring provides 19 IIC rating units (varies depending upon the wood type) and 1.5 inch-thick topping provides 3 IIC rating units. Note that ceramic tile adhered to concrete topping acts in a similar manner as concrete does and provides a low IIC rating of 1.

Therefore, based on the above Impact Insulation Class IIC ratings it can be derived that the Royale Riviera 8 inch-thick hollowcore slabs with 2 inch-thick topping covered with carpet and pad have an IIC rating of 77. Note that this calculation takes into account that the actual topping thickness equals 2 inches and not 1.5. Also, it can be calculated that the same actual slabs with 0.5 inch-thick wood flooring would have an IIC rating of 51 without sound-deadening board and an IIC of 54 with sound-deadening board.

It is the Engineer's opinion that, since the originally required carpet and pad floor covering for the Royale Riviera living and bedroom areas provided such a high impact noise insulation IIC rating of 77 with carpet and pad, alternative floor coverings should provide at least a midrate rating IIC of 55.

In the acoustical consulting business typically the minimum IIC of 50 criteria is used for "low income" or "affordable" housing projects where expectations are lower. In consideration of a still in use U.S. Department of Housing and Urban Development (HUD) document, "A Guide to Airborne, Impact, and Structure Borne Noise Control in Multifamily Dwellings," published in 1967, the Florida Building code minimums, and the Engineer's past experience; the Engineer has developed a recommendation for "average" or "mid-range" criteria taking IIC 55 as a minimum (50 if field tested). For "luxury" and "high end" projects the Engineer recommends a minimum IIC of 58 (53 if field tested).

Because the Royale Riviera apartment units have floor assemblies with no suspended ceiling, the sound barrier alone applied to the floor must work with the concrete floor slab to provide a high sound reduction rating and should be applied in all areas of the apartment.

All tile flooring to be installed anywhere in the unit must have an impact sound insulation underlayment between tile and concrete. Because for wood flooring (depending upon the wood type) the total IIC shall be on the order of 50, the Engineer strongly recommends that an underlayment also be used under wood flooring.

Specifically concerning bamboo flooring the Engineer has found that certain bamboo products require the difference in moisture content between the bamboo flooring and the sub-floor to be

within 2%. For instance, if the bamboo flooring is at 7% moisture content, the moisture content of the sub-floor must be between 5% and 9%. Acclimation of the bamboo flooring on the job site is typically the customer's full responsibility for any unpleasant shrinkage or expansion of the bamboo planks. A moisture barrier underlayment is therefore highly recommended to eliminate any concerns regarding the required moisture difference. This constitutes another reason to install a sound insulating underlayment which is also suitable for application over concrete and acts as a moisture barrier.

The weight added to the hollowcore slab and 2-inch thick topping in the form of flooring shall be limited to 20 psf in order to maintain the slab deflection below L/480, where L is the center to center span length between tenant separation walls and is equal to 27 feet.

The Engineer recommends the use of the following sound control products for tile, stone and wood products. While all products are approved; for each application, the products are listed by order of preference. No local changes in level exceeding 1/4 inch shall be allowed in the flooring installation.

Ceramic Tile/Stone (Thin Bed) Installations.

1.) "QTscu 4005" by Ecore International; 3/16-inch (5 mm) thick rubber-based sound control underlayment adhered to the concrete with approved thinset, a product which according to the manufacturer has been tested in over 200 laboratory tests and which outperforms cork, felt and plastic. The underlayment layer made of 92% recycled rubber provides a field test IIC of 51 on a 7-inch concrete slab with no ceiling.
2.) "Cerazorb" by Impacta; 3/16-inch (5 mm) thick synthetic cork underlayment adhered to the concrete topping with bond coat adhesive designed to attach the underlayment to cured concrete. The underlayment layer provides a field test IIC of 59 on a 7-inch concrete slab with no ceiling.

Laminate/Solid Wood Installations.

1.) "SolidBlack-MD-TPO" by Pak-Lite, Inc. (PLI); 0.08-inch (2 mm) thick underlayment composed of medium density polyolefin foam and polyethylene film developed to reduce noise transmission. The underlayment reduces both reflective sound noise and through the floor sound transmission and is suitable for use over concrete subfloors, exceeds recommended moisture permeability ratings for installation over concrete slabs, helps to eliminate subfloor imperfections, is mold and mildew resistant as well as non allergenic, adds R Value to help insulate floors, and provides an IIC of 72 according to ASTM E 492.
2.) "Royal Walk 2MM" by Simple Floors; another similar polyolefin foam product, 0.08-inch (2 mm) thick which provides an IIC of 58.
3.) "FootFall" by All Noise Control; 0.125-inch (3.2 mm) thick rubber-based floor underlayment made from recycled rubber tires resulting in an IIC of 63 on 8 inch solid concrete slabs.

Attached you shall find the Specifications and the Installation Instructions for the above listed sound control products. Flooring shall be installed following recognized manufacturer specifications.

Please advise if you require additional information or clarifications.

Regards

Hans H. Kowalski, P.E. FL 59388

March 31, 2010

Attachments: "QTscu4005" Specifications and Installation Instructions, 8 pp.
"Cerazorb" Specifications and Installation Instructions, 2 pp.
"SolidBlack-MD-TPO" Specifications and Installation Instructions, 2 pp.
"Royal Walk 2MM" Material Specifications, 1 p.
"FootFall" Information, 2 pp.