WILSON IHRIG

ACOUSTICS, NOISE & VIBRATION

CALIFORNIA
WASHINGTON
NEW YORK

George Paul Wilson, Ph.D., FASA

Dr. Wilson founded, and has been associated with, the successful and renowned acoustical consulting firm of Wilson Ihrig & Associates (Wilson Ihrig) since 1966. Under Dr. Wilson's leadership, based on both his philosophy of providing cost-effective, practical solutions and his technical innovations, Wilson Ihrig quickly gained national and international prominence, as well as a strong and loyal client base in the San Francisco Bay Area where the firm has always been headquartered. Dr. Wilson's accomplishments in the field of acoustics have been recognized by the Acoustical Society of America (ASA) when it granted him Fellow status in 1980 and by the National Council of Acoustical Consultants (NCAC) when it awarded him the C. Paul Boner Award in 1992, and most recently, the 2017 NCAC Laymon Miller Award for Excellence in Acoustical Consulting. Dr. Wilson also served as NCAC President from 1980 to 1982.

Experience Prior to Consulting

After receiving a Master's Degree in Mechanical Engineering from University of California, Berkeley in 1956, Dr. Wilson worked at Boeing Airplane Company for two years. The work primarily addressed B-52 aircraft structural fatigue from jet noise and the reduction of jet noise, but it also included research on acoustical laboratories throughout the United States in preparation for the design of a new acoustic laboratory for Boeing. From 1958 to 1964, he returned to UC Berkeley to obtain a Ph.D. in acoustics and vibration. His doctoral work included teaching upper division classes in Mechanical Engineering; particularly a new class he developed titled *E-173 Noise Control*. Dr. Wilson taught this class himself for four years. The course is still included in the UC Berkeley Mechanical Engineering program but is now titled *173 Fundamentals of Acoustics*.

In addition to research work for his doctoral thesis, Dr. Wilson designed, specified, and oversaw the construction of two separate acoustical laboratories at UC Berkeley. The first was completed in 1959 at the UC Richmond Field station and included a fully isolated anechoic chamber and two reverberation chambers. The reverberation chambers interior dimensions were 15′x13′x9′, with one located above the other and with a 7′x7′ hole between them for testing the transmission loss of floor assemblies. This facility was later used for testing sound transmission through finite dimension holes or apertures, the subject of Dr. Wilson's thesis.

From 1962 to 1964, as part of the work as a UC Instructor, Dr. Wilson designed a second acoustical laboratory for the basement of the new mechanical engineering building, Etcheverry Hall. This acoustics laboratory included a large workspace and two, large, side-by-side, completely vibration isolated reverberation chambers with an opening in the common wall for testing the transmission loss of wall assemblies.

Wilson, Ihrig & Associates is Established

After completing the Ph.D. program and graduating, Dr. Wilson's first job was teaching mechanics to freshman undergraduates at UC Santa Barbara, not acoustics. This was followed by a year working for an established acoustical consultant whose practice was limited to architectural acoustics and which did not present the potential for noise and vibration control consulting. Taking his professional interests and expertise in his own hands, Dr. Wilson decided to launch his own independent acoustical consulting firm in 1966.

Early on, because of the innovative and creative solutions Dr. Wilson developed, the firm established an international practice; particularly in the fields of noise and vibration control for rail systems and the vibration isolation of performance halls and other noise sensitive buildings. Shortly after Wilson Ihrig was founded, the San Francisco Bay Area Rapid Transit District (BART) invited Dr. Wilson to bid on a BART test track measurement program. The work done by Dr. Wilson was so well received, that BART has been an on-going client for the firm ever since. Additional clients followed, including Washington Metropolitan Area Transit Authority (WMATA), Baltimore Metro (MTA), Toronto Transit Commission (TTC) and the Metropolitan Atlanta Rapid Transit Authority (MARTA).

Rail System Floating Slab Track (FST)

The first big innovation to come from Wilson Ihrig was conceived in the early 1970s. At that time, rail system Floating Slab Track (FST) assemblies had to be heavily damped to control vibration amplification at the floating slab resonance. In 1970, Dr. Wilson completed an analysis that indicated that because the excitation force is a non-coherent, moving, impact load, it is not necessary to have damping in order to avoid significant amplification at the floating slab resonance frequency. Tests at WMATA and TTC confirmed that FST without damping had only 3 to 5 dB amplification at the resonance frequency, as had been predicted by Dr. Wilson.

The success of the early designs developed for a FST, especially the discontinuous or "double tie" design developed for the TTC, resulted in wide spread adoption of the discontinuous design with natural rubber resilient support pads as the configuration to be used for control of ground borne noise and vibration from subway and surface rail systems. It also became the track support design used to reduce airborne noise radiated by aerial structures and bridges. The FST design conceived and developed by Dr. Wilson has enabled the development of dozens of rail transit systems in noise sensitive areas without causing significant environmental noise or vibration impacts.

Building Vibration Isolation for Noise Control

A natural extension of the work on FST vibration isolation was to apply the same design ideas and materials to the isolation of buildings from ground-borne or structure-borne vibration and noise. In the period from 1955 to about 1990, most consultants in the United States believed that lead-asbestos pads were the best available structural isolation material. Many buildings in the Eastern United States were isolated on lead-asbestos pads even though performance was limited. During this period, there were multiple examples of buildings isolated on rubber pads in the United Kingdom, which Dr. Wilson concluded provided a much better isolation design. Dr. Wilson began using natural rubber support bearing pads for building isolation in the 1980s. Early projects included the Birmingham Concert Hall (1980) and the Burnham Plaza Theater (1986), both of which were successfully isolated from ground-borne noise produced by adjacent rail systems.

The first major U.S. concert hall isolation design project for Wilson Ihrig was Benaroya Hall in Seattle, with design starting in 1994 and opening in 1998. The ideal site for Benaroya was in Downtown Seattle near the Seattle Art Museum and Pike Place Market, however the site was directly over a freight and passenger train tunnel and directly adjacent to a bus and light rail tunnel. The site was initially considered unacceptable by the hall acoustician, Dr. Cyril Harris, but his mind was changed when Dr. Wilson determined that a two-stage isolation system could be designed to reduce ground-borne noise from trains to levels below the threshold of hearing with the air conditioning turned off. This project was the first completely vibration isolated performance hall in the United States.

The first stage of the Benaroya Hall isolation system was a very heavy mass foundation built to decrease transmission of the noise and vibration from the ground to the main building, as opposed to a normal mass foundation. The second stage was the performance hall's box-in-box structure within the main building structure. The performance hall is supported by 7-inch thick natural rubber pads to further reduce noise and vibration from trains in the tunnel below. A unique feature of the isolation system design was that the resilient support pad arrangement included lateral restraint pads of the same thickness as the gravity load support pads to provide the same degree of noise and vibration reduction. The lateral pads were pre-compressed and sized to support lateral loads in any direction from an earthquake of up to 0.75 g. This was completely different from most isolation designs which provided only lateral restraint buffers or bumpers: an arrangement that does not maintain the isolation or protect the isolated structure from damage due to seismic events.

With the success of the building isolation configurations and details developed by Dr. Wilson on the Benaroya Hall project, those innovations have been incorporated in the design of 14 other performance halls to reduce ground-borne noise and vibration from trains and other noise and vibration sources. Thousands of people now live and work near rail lines without having excessive levels of noise, ground-borne noise, or perceptible vibration and can enjoy the quietest passages of symphonic music without the distraction of a passing train.

Wilson attributes much of its reputation and longevity to Dr. Wilson's many innovations in the areas of rail and building vibration isolation that have made seemingly impossible projects possible. His innovations and over half a century of noise, vibration, and acoustical knowledge have inspired the next generation of acoustical consultants who have joined the firm to follow in the steps of its founder.