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PROJECTS AND EXPERIENCE LIST

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1.) HIGHWAY NOISE PROJECTS:

- ***Vergennes Planning and Environment Linkages*, Vermont Department of Transportation, Vergennes, VT (2021)** - Performed existing condition traffic noise and vibration measurements for two locations along Main Street in downtown Vergennes. Noise levels were measured with Svantek SV-971 noise monitors and evaluated against FHWA/VTrans guidelines, and vibration levels were measured with InstanTel MiniMate seismometers and evaluated against FTA guidelines. Parsons Brinckerhoff.
- ***HRBT Traffic Noise and Jet Fan Noise Review*, Virginia Department of Transportation, Chesapeake, VA (2021)** – Performed submittal reviews of traffic noise assessments and jet fan noise assessments as owner’s engineers representing VDOT for the Hampton Roads Bridge Tunnel project. Parsons Brinckerhoff.
- ***Route 9 Residential Noise Control*, Wellesley, MA (MMXXI)** – Assisted a private residence located on Route 9 in Wellesley to consider improvements to their self-made traffic noise control measures, primarily consisting of a noise barrier fence. Thal-Asc.
- ***NC-73 (R-5706) Highway Widening Traffic Noise Study*, North Carolina Department of Transportation, Mecklenburg and Cabarrus Counties, NC (2019)** – Oversaw a traffic environmental noise study for widening and improvements to NC-73 in accordance with FHWA/NCDOT requirements. The project involved four potential design alignments through approximately a 12 mile corridor. Ambient and traffic noise levels were measured at fifteen sites, and Existing and Future traffic noise levels were predicted at some 1,200 receptors using the FHWA’s Traffic Noise Model (TNM). Twenty noise barriers were recommended for further consideration in accordance with NCDOT’s barrier cost-effectiveness guidelines. Parsons Brinckerhoff.
- ***US Army Northern Landing Bridge Traffic Noise Study*, United States Army, Virginia Beach to Chesapeake, VA (2019)** – Performed a traffic noise study in support of a swing bridge replacement project in accordance with FHWA and VDOT traffic noise policies. Ambient and traffic sound level measurements were performed throughout the project area, and 2015 Existing, 2040 No-Build and 2040 Build traffic noise levels were predicted in the affected community using the Cadna-A noise model augmented with the FHWA TNM module. Parsons Brinckerhoff.
- ***New Haven Route 34 CATEX Phase 3*, Connecticut Department of Transportation, New Haven, CT (2018)** – Performed the highway noise environmental assessment of proposed changes to Route 34 Downtown Crossing serving New Haven. Long-term ambient noise levels were monitored, short-term traffic noise levels were measured, and 2018 Existing and 2038 Future traffic noise levels were computed using the FHWA TNM model. Six of the twenty noise receptor locations were expected to be exposed to excessive future traffic noise levels associated with the project, however none of them could be mitigated in a feasible or reasonable manner in accordance with CTDOT policy. Parsons Brinckerhoff.
- ***Highway Noise Barrier Gap Performance Degradation*, Illinois Tollway Authority, Downers Grove, IL (2018)** – Provided expert guidance for a task order to explore the noise reduction degradation effects that could be expected from an offset gap in a highway noise barrier caused by a bridge or other structural element being built with a horizontal gap between it and a given noise barrier. Used the Cadna-A model and FHWA’s TNM model to simulate various barrier circumstances and reduced the results into normalized relationships based on gap size, barrier size and receptor locations. Parsons Brinckerhoff.
- ***PNSY Bridge No. 1 Noise Assessment; Portsmouth Naval Shipyard, Kittery, ME (2015)*** - Performed an assessment of potential traffic noise benefits/consequences for a series of proposed design changes to Bridge No. 1 accessing the Portsmouth Naval Shipyard. Used the Cadna-A model to predict bridge traffic noise levels at nearby receptors in Kittery anticipated with changing the bridge deck from open-grated to solid concrete with the addition of clear Plexiglas wind barriers along the sidewalks. Parsons Brinckerhoff.
- ***ATS Bus Facility Environmental Assessment*, Albany Transit System, Albany, GA (2015)** - Performed a noise assessment using the Cadna-A model to evaluate potential community noise impacts associated

with the construction and operation of a new bus facility in Albany, Georgia. The noise assessment was conducted in accordance with procedures, criteria and prediction algorithms contained in the Federal Transit Administration's (FTA) Transit Noise and Vibration Impact Assessment Manual (2006). Parsons Brinckerhoff.

- ***Backyard Turnpike Noise Barrier, Weston, MA (MMXIII)*** – Performed a highway noise assessment for a private residence at 199 Winter Street in Weston, MA. The goal was to explore potential noise barrier designs to reduce traffic noise levels in the backyard produced by the Massachusetts Turnpike. The Cadna-A noise model with the FHWA TNM module was used to simulate traffic noise conditions in the backyard and to evaluate the noise reduction performance of various noise barrier designs. Noise barriers ranging in height from 12 ft to 24 ft tall were modeled and evaluated. Thal-Asc.
- ***New Hampshire I-93 Widening Project Noise Barriers, New Hampshire Department of Transportation (NHDOT), Derry to Manchester, NH (2013)*** - Provided final design and review services for five highway noise barriers that had been approved as part of the NH I-93 Widening project. Confirmed each barrier's Cost Effectiveness Index after taking in to account any new developments since the time the projects EIS had been approved. Provided guidance on noise barrier design and performance implications for a newly proposed Exit 4A Interchange. Parsons Brinckerhoff.
- ***Long Wharf Special Land-Use Noise Study, Connecticut Department of Transportation, New Haven, CT (2011)*** – Performed site-specific noise analyses to evaluate traffic noise impacts and possible mitigation measures for two special land-use areas (Nature Preserve and Vietnam Memorial Park) along I-95 in New Haven. Traffic noise levels were modeled using the FHWA TNM model for Existing, No-Build and Build Alternatives for an exit ramp that might impact the special land-use areas. Octave band ambient noise measurements were performed throughout both land-use areas and propagation behavior empirical models were developed. Evaluation of results was performed in accordance with ConnDOT's new policy specifically addressing such non-residential special land-uses. Parsons Brinckerhoff.
- ***Rte 34 New Haven TIGER II Grant Project, City of New Haven, New Haven, CT (2010)*** – Performed a traffic noise and construction noise evaluation of proposed enhancements to the Rte 34 corridor in New Haven for a Categorical Exclusion as part of a Federal TIGER II Grant application. Existing and potential future traffic noise levels were evaluated using the Cadna-A model, and future traffic noise levels were estimated using the FHWA TNM model. Predicted noise levels were evaluated for impact against ConnDOT's new 2011 traffic noise policy. Noise impacts were not found so the CatEx could proceed on schedule. Parsons Brinckerhoff.
- ***DFW Connector Project, Texas Department of Transportation, Dallas, TX (2009)*** – Enhanced the project's previously approved TNM models in order to evaluate potential traffic noise consequences at the Baylor Hospital associated with changes to two nearby ramps. The noise assessment was performed in accordance with 23 CFR 772 (FHWA Noise Abatement Criteria) and TxDOT Highway Traffic Noise Guidelines. Parsons Brinckerhoff.
- ***Whittier Bridge Replacement Project, Massachusetts Department of Transportation, Amesbury/Newburyport, MA (2012)*** - Performed entire EIS traffic noise component to replace the historic Whittier Bridge over the Merrimac River. Ambient noise levels were monitored at ten receptor locations adjacent to I-95 from Exits 57 to 60, and TNM models were developed to evaluate future traffic noise consequences and potential noise barrier mitigation measures for several project alternatives. The noise analysis was done in accordance with the newly revised 23 CFR 772 (FHWA Noise Abatement Criteria) and new 2011 MassDOT Traffic Noise Policy. Also supported MassDOT as Owner's Engineer overseeing construction of the new bridge. Parsons Brinckerhoff.
- ***Fort McHenry Tunnel Roadway Slab Vibration Study, Maryland Transportation Authority, Baltimore, MD, (2009)*** – Performed vibration measurements on the roadway slabs inside all four tunnel bores of the Fort McHenry Tunnel with live traffic traveling through the tunnel. Performed spectral analysis of vibration acceleration, velocity and displacement levels and compared the results against relevant criteria to determine if the roadway slabs were being subjected to excessive vibration potentially exacerbating their

deterioration (cracking, spalling). The study concluded that traffic-induced vibration levels were not a concern for damaging the 16-inch thick concrete roadway slabs. Parsons Brinckerhoff.

- ***Page-Olive Connector Project, Missouri Department of Transportation, St. Louis, MO (2009)*** – Provided expert opinion for St. Louis County for noise matters for a new 3-mile connector project. Oversaw a team who performed retroactive ambient noise monitoring and traffic volume counts in order to complete an EIR prepared by others. The most important task was to calibrate the project's TNM models, which had been developed by others, with actual field measurement noise and traffic data. Also performed validation and expansion of the project's TNM model files by inserted additional ramps, and critical reviewed noise barriers designs proposed by the Design-Build contractor. Later provided expert witness testimony and critically reviewed opposition's acoustical report when the project was challenged in court by members of the Terra Vista community. Parsons Brinckerhoff.
- ***MIT Urban Ring Advisory Project, Massachusetts Institute of Technology, Cambridge, MA (2007)*** – Participated on team of experts advising MIT of potential implications with newly proposed BRT bus route along Vassar and Albany Streets as part of the Massachusetts EOT Urban Ring Project. Reviewed project EIS sections for noise and vibration, and computed potential vibration impact zones for sensitive instrumentation on MIT's campus. Parsons Brinckerhoff.
- ***Pre-Certified for Noise Analysis in Massachusetts, Massachusetts Highway Department, Boston, MA (2007)*** – Assembled and submitted qualifications and credentials form ADM-016 in order to be pre-certified by the Massachusetts Highway Department to perform noise-related studies. Approval was granted in July 2007. Parsons Brinckerhoff.
- ***Alaska Way Viaduct Southern End EA, Washington State Department of Transportation, Seattle, WA (2007)*** – Reviewed and advised on a report for the noise analysis of the southern end of the Alaska Way Viaduct project which involved SR 99 from South Holgate to South King Street in Seattle, WA. The noise analysis included measurements and existing and future noise predictions using the FHWA TNM model. A qualitative assessment of potential construction noise impacts was also performed. Parsons Brinckerhoff.
- ***Oregon US 730 Irrigon to Umitilla EA, Oregon DOT, Portland, OR (2007)*** – Reviewed and advised on a report for the noise analysis of two miles of US 730 connecting Irrigon and Umitilla, OR. The noise analysis included measurements and existing conditions predictive modeling using the FHWA TNM model. A qualitative assessment of potential construction noise impacts was also performed. Parsons Brinckerhoff.
- ***Connecticut I-95 Long Wharf EA, Connecticut DOT, New Haven, CT (2006)*** – Prepared the traffic noise section of the Environmental Assessment evaluating three proposed alternatives including an expansion of I-95 and a Ring Road through New Haven. Existing noise levels and traffic counts were measured at 17 receptor locations, and existing and future traffic noise levels were predicted at over 100 receptor locations using the FHWA TNM model. Two noise barriers were found to be warranted for further consideration in accordance with ConnDOT's cost-effectiveness policy. Additional analysis was performed to evaluate noise impacts to parks within the study area. Parsons Brinckerhoff.
- ***NH Route 1 Bypass EA, New Hampshire DOT, Portsmouth, NH (2006)*** – In support of the Route 1 Bypass EA, a study was conducted to assess the potential traffic noise consequences for residences and institutional land-uses along a 2½ mile section of Route 1 near the Portsmouth rotary. Existing noise conditions were measured at ten receptor locations using LD720 noise monitors, and evaluated against both FHWA and NHDOT traffic noise criteria. Existing, future no-build and future build traffic noise levels were predicted using the TNM model for over 400 receptors, and candidate traffic noise mitigation measures consisting of three traffic noise barriers were evaluated using NHDOT's cost-effectiveness index procedures. The results of the study were presented to NHDOT officials, the Citizens Advisory Committee, and at several public meetings. Parsons Brinckerhoff.

- ***Rhode Island Rt 6 / Rt 10 Intersection EIS, Crossman Engineering, Providence, RI (2004)*** - A noise study was conducted as part of the EIS process to assess potential traffic noise and construction noise impacts for renovating and expanding the Rt 6 / Rt 10 Interchange in Providence, RI. Existing noise levels were measured at six receptors in the project area, and more than 400 receptors were evaluated for potential traffic noise impacts against FHWA and RIDOT criteria using the TNM model for the existing, future no-build and future build cases. Eventually six traffic noise barriers, ranging in heights from 15 to 25 feet tall, were found to be warranted based on RIDOT's cost-effectiveness index procedures. Parsons Brinckerhoff.
- ***Elimination of Broad Street Extension Notice of Project Change, Central Artery/Tunnel Project, Boston, MA (2004)*** - A traffic noise study was conducted as part of the NPC process required for filing through the Massachusetts Executive Office of Environmental Affairs. Fourteen receptors in downtown Boston were evaluated for potential traffic noise impacts due to the elimination of the Broad Street Extension and the merging of Parcels 17A and 17B. Traffic noise levels for the design year 2010 were predicted using the FHWA-approved Traffic Noise Model (TNM) and evaluated against MHD and FHWA traffic noise criteria limits. The results indicated that future noise levels were expected to decrease at all but two receptor locations, and that mitigation measures such as barriers for those two receptors would be impractical and unjustified. Parsons Brinckerhoff.
- ***City Background Noise Reduction Study, Central Artery/Tunnel Project, Boston, MA (2004)*** - A comparative study of previous and newly collected community noise measurement data was performed in order to quantify the reduction in city background noise resulting from the relocation of I-93 traffic into newly completed underground tunnels. With the final relocation of traffic on 12/20/03, Bostonians and project staff immediately noticed how much quieter the city had gotten, which in turn led to questions concerning the potential need to adjust the Project Noise Spec's relative noise criteria limits and the possibility that additional construction noise complaints might result due to the diminished masking noise. A study of eight noise receptors in the Downtown and North End areas of the project revealed that indeed background noise levels had reduced by an average of 4 dBA L90 during the daytime and by 6 dBA L90 during the evening and nighttime. A policy strategy was developed for the project in case any additional noise complaints resulted, which did not turn out to be the case. This case study was presented as a technical paper at NoiseCon 2004. Parsons Brinckerhoff.
- ***Framingham Traffic Noise Barrier Re-evaluation, Massachusetts Turnpike Authority, Framingham, MA (2002)*** - In response to significant community outcry, a traffic noise barrier study was performed to reconsider erecting noise barriers along the Turnpike in the Town of Framingham. Current traffic noise levels were measured at 25 receptor locations, and traffic noise conditions were modeled using the FHWA Traffic Noise Model (TNM). Each candidate barrier's Cost-Efficiency and Priority Indexes were computed. The results were reconciled against the Turnpike's pilot noise barrier prioritization study originally performed in 1992. Where appropriate, new cost and performance guidelines were developed in order to justify recommendations on which noise barriers to pursue. Ultimately one noise barrier was recommended for final design estimated to cost over \$1 million. Refinements to the barrier allowed for a shorter-height less expensive barrier to be designed within MTA's budget. The Westgate Road noise barrier was built in 2003. Parsons Brinckerhoff.
- ***I-95 Q-Bridge Reconstruction Project, ConnDOT, East Haven, CT (2001)*** - Traffic noise potential consequences were evaluated for a particular neighborhood on Interstate I-95 which had not been previously evaluated for traffic noise impact in the project's EIS. Existing traffic noise conditions were documented through noise measurements at one residential receptor location. Existing and future traffic noise levels were predicted using the FHWA-approved Traffic Noise Model (TNM). Whereas predicted traffic noise levels were expected to exceed FHWA noise abatement criteria, a traffic noise barrier was recommended and preliminarily designed for ConnDOT's consideration. The noise barrier was both acoustically and economically justified per ConnDOT guidelines. Parsons Brinckerhoff.
- ***Rhode Island Resource Recovery Project, Rizzo Associates, Providence, RI (MM)*** - Potential truck traffic noise impacts at two receptor locations traffic noise barrier were evaluated as part of a landfill expansion project in Rhode Island. A previously proposed traffic noise berm and barrier was examined using the FHWA-approved Traffic Noise Model (TNM) and found to be justifiably effective. Thal-Asc.

- ***Riverlife Walkway Project, Pittsburgh, PA (2000)*** - The City of Pittsburgh wished to develop an open air market area along the Monongahela River and had concerns about the suitability of the noise environment due to nearby traffic noise from Interstate I-376. Noise measurements were performed on the proposed walkway and the results were evaluated against various noise criteria for compatible land-use. Noise mitigation options, primarily involving the use of draped noise control curtains and absorption treatments under the elevated roadway, were developed and recommended for the City's consideration. Parsons Brinckerhoff.
- ***Bulfinch Triangle Notice of Project Change, Central Artery/Tunnel Project, Boston, MA (2000)*** - In support of a proposed change in the CA/T Project's final surface street alignment, a traffic noise study was conducted as part of the NPC process required for filing through the Massachusetts Executive Office of Environmental Affairs. Nine receptors in the area known as Bulfinch Triangle were evaluated for potential traffic noise impact by using the FHWA-approved Traffic Noise Model (TNM). The model was able to show that anticipated noise impacts did not warrant mitigation because they were due to pre-existing traffic noise conditions which were actually expected to be slightly reduced by the proposed action. The NPC was eventually filed and received EOEAA-approval. Parsons Brinckerhoff.
- ***East Boston Three-Way Land Exchange ENF, Central Artery/Tunnel Project, Boston, MA (2000)*** - Traffic noise consequences were analyzed in support of an Expanded ENF involving the land-use exchanges of three parcels in East Boston. This land swap was essential to allow the CA/T Project to begin construction of its C08A1 contract. Ambient noise readings were collected, and six noise sensitive receptors were analyzed for the design year 2010 using the FHWA's new traffic noise model TNM. The results were submitted to MEPA and presented to the affected East Boston community. Parsons Brinckerhoff.
- ***US Postal Service Land Exchange ENF, Central Artery/Tunnel Project, Boston, MA (1999)*** - In response to concerns raised by residents at 249 A Street, traffic noise potential consequences associated with the reuse of parking lot areas by the US Postal Service were analyzed as part of an ENF submitted through the MEPA process. Ambient noise readings were performed, and future year 2010 traffic noise conditions were predicted using the FHWA's traffic noise model TNM. The study focused on those time periods when the parking lots would experience a shift change of USPS employees, and the results indicated that no traffic noise impacts were expected. Parsons Brinckerhoff.
- ***Route 6 Connecticut EIS, DeLeuw Cather Company, Bolton/Coventry, CT (1995)*** - Three highway alignment alternatives were considered intended to provide relief to Connecticut's Route 6. The proposed alignments would cut through previously undeveloped rural areas in Bolton and Coventry. Noise impact was identified utilizing the STAMINA highway noise model. Where warranted, 20 noise barriers were preliminarily considered and modeled as well. KM Chng Environmental.
- ***Route 3 North Toll Alternative EIS, Fay Spoffard & Thorndike, Tyngsboro/Chelmsford/Billerica, MA (1995)*** - The relative noise consequences associated with two MHD-proposed toll plazas across Route 3 North as part of a third lane scheme were evaluated with respect to diverting traffic. Four interchanges were examined using the STAMINA highway noise model. In addition, a proposed site of a service area was evaluated with ambient noise measurements and predictions to nearby receptors. KM Chng Environmental.
- ***I-89/Route 12-A Renovations EIS, Fay Spoffard & Thorndike, Lebanon, NH (1994)*** - Performed environmental impact assessment of proposed renovations and widening of I-89 and Route 12-A through Lebanon, NH. Developed the STAMINA baseline models and validated with field measurements. KM Chng Environmental.
- ***Nashua Circumferential Bypass Environmental Impact Study, Nashua, NH (1991)*** - Advised and participated on noise EIS section assessing six proposed bypass highway alignments to the east of downtown Nashua on behalf of the NHDOT. KM Chng Environmental.

- ***N.Y. City Sludge Facility Environmental Assessment, New York, NY (1991)*** - Reviewed and critically commented on mobile noise study EA section for various proposed new sludge facility placements prepared on behalf of the NYCDEP. Thal-Asc for Stone & Webster.
- ***Route 24 / West Ring Factory Road Court Appeal, Baltimore, MD (1991)*** - Performed residential noise measurements on behalf of a public citizen's action group to prevent the proposed widening of a residential roadway. Thal-Asc for Lewis Goodfriend & Associates.
- ***Clermont I-95 Interchange, Clermont, VA (1990)*** - Performed the noise section of the Environmental Impact Study for the Virginia DOT. Prepared and validated computer model, modeled baseline and future proposed noise levels at over 30 receptors, identified predicted noise impacts and recommended mitigation treatments (including noise barriers). Louis Berger & Associates.
- ***Route 6 Cape Cod Double Barreling, Cape Cod, MA (1990)*** - Performed the noise section of the Environmental Impact Study for the Mass DPW. Performed field measurements at over 20 receptors along 13 miles of Route 6, prepared and validated computer noise model, established baseline noise levels. Louis Berger & Associates.
- ***Presque Isle Route 1 Bypass, Presque Isle, ME (1990)*** - Performed the noise section of the Environmental Assessment for the Maine DOT. Performed field measurements at over 12 receptors surrounding Presque Isle, prepared and validated computer noise model, established baseline noise levels. Louis Berger & Associates.
- ***Las Vegas Southern Beltway, Las Vegas, NV (1990)*** - Performed the noise section of the Environmental Impact Study for the Nevada DOT. Prepared computer model for some 50 receptors and over 30 miles of a proposed new beltway highway, identified predicted noise impacts, recommended mitigation treatments (including noise barriers). Louis Berger & Associates.
- ***Alewife Brook Parkway / Route 2, Arlington, MA (1989)*** - Performed noise section of Environmental Impact Study for the Mass DPW. Collected highway noise measurements at 15 receptors, modeled noise levels at over 30 receptors, established baseline and predicted future noise levels, identified noise impacts. Bolt Beranek & Newman, Acentech.
- ***Volpe Transportation Systems Center (USDOT), Cambridge, MA (1990)*** - Performed laboratory acoustic properties testing on experimental highway barrier material and configuration. Absorption coefficients and acoustic impedance values were determined using reverberation room technique and impedance tube method. Bolt Beranek & Newman, Acentech.
- ***The Vineyard Development, Weston, MA (1989)*** - Performed environmental and highway noise impact survey for a proposed new condo development adjacent to the Mass Turn Pike. Bolt Beranek & Newman, Acentech.
- ***Williamsville Toll Station, New York Thruway, NY (1989)*** - Performed highway noise measurements at twelve receptors surrounding the toll station as part of a highway noise barrier design study. Bolt Beranek & Newman, Acentech.

2.) AIRPORT NOISE PROJECTS:

- ***Mary Bridge Childrens Hospital Helicopter Noise, Tacoma, WA (2021)***– Performed a noise assessment of the surrounding community and of the new hospital buildings due to emergency medivac helicopter operations in and out of the hospital. Used the Cadna-A noise model augmented with the FAA AEDT model for helicopter noise sources for community noise predictions. Evaluated results against the Washington State and City of Tacoma noise regulations. Parsons Brinckerhoff.
- ***New Valley Hospital Runway 19 Opposition, Colden Corporation, Peabody, MA (MMXXI)***– Performed a peer review and noise modeling to assist New Valley Hospital in their opposition to new Runway 19 flight paths proposed by Teterboro Airport in Paramus, New Jersey. Performed Cadna-A noise modeling to assess aircraft noise at new hospital location, and assisted hospital in opposition arguments presented to FAA representatives. Thal-Asc.
- ***Penn State Health Buildings Helicopter Noise Predictions, HKS Architects, Lancaster, PA (2021)*** - Performed helicopter noise predictions using the Cadna-A model for use in selecting appropriate external windows and facade design for two new hospital buildings. Used the FAA's AEDT Model to get sound emission levels for an Airbus H155 helicopter that was expected to land on top of the hospital for emergency patient transport. Parsons Brinckerhoff.
- ***Plymouth Airfield EA, Campbell & Paris Engineers, Plymouth, MA (1994)*** - Performed extensive community noise measurements and aircraft event collection utilizing three noise monitors simultaneously at a total of 6 locations to evaluate existing aircraft noise conditions surrounding the airfield as part of a runway extension assessment. KM Chng Environmental.
- ***Minuteman Airfield Noise Impact EA, Daylor Associates, Stow, MA (1994)*** - General aviation and helicopter noise evaluation mandated by the FAA. Responsible for ambient and aircraft event specific noise monitoring program surrounding airfield. Assisted with INM model development and validation. KM Chng Environmental.
- ***Runway 27 Environmental Impact Study, Logan International Airport, Boston, MA (1991)*** - Performed noise measurements in neighboring residential communities in an effort to document and assess aircraft noise impact for three alternative flight tracks under FAA consideration. Thal-Asc for Wyle Laboratories.
- ***West Palm Beach Airport, FL (1989)***- Participated on team developing airport noise measurement system, designed outdoor monitoring poles, and trained staff in use of equipment. Bruel & Kjaer.
- ***Assisted with Airport Noise Measurement Systems (1985-1989)*** presentations, demonstrations and proposals for several airports including Boston, Orlando, St. Louis, Los Angeles, Orange County, Ft. Lauderdale, Minneapolis, Atlanta, etc. Bruel & Kjaer promotional activity.

3.) TRANSIT AND RAILROAD NOISE & VIBRATION PROJECTS:

- ***B&P Frederick Douglas Tunnel Replacement, Amtrak, Baltimore, MD (2022)*** - Performed an updated community noise and vibration impact analysis to evaluate changes in the design of the B&P Tunnel for the purposes of determining suitable real estate subsurface easement compensation for residences above the tunnel. Construction noise and vibration levels as well as future operational noise and vibration levels were all evaluated in accordance with FTA/FRA guidelines. The Cadna-A model was used to predict noise levels, and FTA and WSP spreadsheet models were used to predict vibration levels. The results were presented to Amtrak to allow them to determine any momentary compensations. Also developed the project's Construction Noise and Vibration Specifications, particularly with regards to potentially impacted historic properties. Parsons Brinckerhoff.
- ***Park Avenue Rail Viaduct, Metropolitan Transportation Authority, New York, NY (2022)*** - Performed calculations to confirm that previously made noise and vibration related commitments in the project's Categorical Exclusion were still expected to be true for the renovation of a mile-long section of elevated light rail tracks. Used the FTA rail noise and vibration model spreadsheets to confirm that future levels would not be greater than existing levels along Park Avenue. Assisted in design of new wayside rail noise barriers for top edges of the viaduct. Also developed the project's Construction Noise Specification based on FHWA guidelines. Parsons Brinckerhoff.
- ***MBTA South Side Maintenance Facility, Massachusetts Bay Transportation Authority, Boston, MA (2022)***- Performed an environmental community noise analysis of a proposed expansion of the MBTA's passenger rail layover facility. The expansion would allow for additional trainsets to layover and receive light maintenance and cleaning. Ambient noise levels were measured at six receptor locations, and anticipated community noise levels were evaluated using the Cadna-A noise model against FTA/FRA noise criteria limits. The results indicated that a 350 foot long noise barrier would be needed to mitigate idling train layover noise from impacting one neighborhood. Parsons Brinckerhoff.
- ***Amtrak R4 Resiliency Generator Upgrades, Amtrak, Manhattan and Queens, NY (2022)*** – Performed community noise assessments at both ends of a passenger rail tunnel in New York City at which upgraded emergency power generators were going to be installed. Ambient noise levels were measured in the communities, and generator noise predictions were performed using the Cadna-A model. The results were evaluated against FTA/FRA noise criteria limits, and noise specifications were developed for the replacement generators in order to comply with FTA/FRA's limits. Parsons Brinckerhoff.
- ***MBTA Fairmont Line Bridge Vibration, Massachusetts Bay Transportation Authority, Boston, MA (2021)*** – Developed the community Construction Vibration Specification 02018 for a commuter rail bridge renovation project which involved vibration limits for both building damages (0.500 inch/sec PPV) and human annoyance (75 VdB RMS) based on FTA guidelines. Reviewed and critiqued contractor submittals. Parsons Brinckerhoff.
- ***MBTA North Cambridge Bus Facility Electrification, Massachusetts Bay Transportation Authority, Cambridge, MA (2021)*** – Performed noise calculations to assess community noise compliance with the Cambridge City Noise Ordinance associated with the new electrification of the bus fleet at the MBTA's North Cambridge bus depot. Parsons Brinckerhoff.
- ***Freeman Avenue Rail Overpass, Federal Rail Administration, Chesapeake, VA (2021)*** – Performed a community noise study to assess the building of an overpass of Freeman Avenue to replace an existing rail street crossing in accordance with FRA Manual and FHWA noise criteria. Performed long-term ambient noise monitoring to establish existing noise levels at three receptor locations using Larson Davis 720 noise monitors, and observed and documented train passby events for train consists, speeds and use of horns. Parsons Brinckerhoff.
- ***NHHS Cooper Street Grade Crossing Warning Horn System Assessment, Connecticut Department of Transportation, Meriden, CT (2019)*** – Performed a controlled study of rail warning horn noise levels in the community proximal to the Cooper Street grade crossing. Performed observed sound measurements at

six locations for two weeks; one week with the trains using their regular locomotive-mounted horns and one week using previously installed pole-mounted wayside warning system horns. Assessed the results relative to one another, to the ambient noise levels occurring at the time, and to train horn regulations found in 49 CFR Parts 222 and 229. Parsons Brinckerhoff.

- ***CAHSR San Francisco to San Jose EIS Review, California High Speed Rail Project, San Francisco to San Jose, CA (2019)*** – Performed a peer review of the environmental impact study performed by others for the CAHSR section from San Francisco to San Jose. Provided critical review comments and approved revisions. Parsons Brinckerhoff.
- ***CAHSR Grasslands Noise Barrier Assessment, California High Speed Rail Project, Grasslands Ecological Area, CA (2019)*** – Performed a special assessment of a proposed high speed rail noise barrier and its ability to reduce train noise for sensitive wildlife adjacent to the rail corridor. Used the Cadna-A noise model to assess several barrier design options including a typical vertical barrier, a barrier with a slanted cantilever top, and a full enclosure barrier tunnel. Waterfowl noise criteria to meet included limits for permanent and temporary hearing damage and avoidance of masking or arousal sound levels. Parsons Brinckerhoff.
- ***CAHSR Volta Noise Barrier Assessment, California High Speed Rail Project, Volta Ecological Area, CA (2023)*** – Performed a special assessment of a proposed high speed rail noise barrier and its ability to reduce train noise for sensitive wildlife adjacent to the rail corridor. Used the Cadna-A noise model to assess several barrier design options including a typical vertical barrier, a barrier with a slanted cantilever top, and a full enclosure barrier tunnel. Waterfowl noise criteria to meet included limits for permanent and temporary hearing damage and avoidance of masking or arousal sound levels. Parsons Brinckerhoff.
- ***NHHS Kensington Road Noise Barrier Assessment, Connecticut Department of Transportation, Berlin, CT (2018)*** – Performed an in-depth assessment as part of the NHHS rail project of the need and justification of a noise mitigation barrier along Kensington Road. Performed ambient noise measurements and computed rail noise impacts on four homes due to proposed future rail operations in accordance with FTA criteria. Used the Cadna-A model to evaluate the effectiveness of various noise barrier designs along the rail right-of-way and computed the cost-effectiveness index of the barriers in accordance with CTDOT policy. Parsons Brinckerhoff.
- ***New Haven - Hartford - Springfield Rail Project Wayside Horn Zones, Connecticut Department of Transportation, Meriden, CT (2018)*** – Performed a series of wayside horn noise modeling assessments of rail/street crossings associated with the proposed NHHS rail project in Connecticut. Pole-mounted wayside horn noise levels were shown as colored isopleth sound contour zones in the proximal community using the Cadna-A model to help evaluate potential horn-free quiet zones. Parsons Brinckerhoff.
- ***Metrolinx Noise Policy Development, Metrolinx, Toronto, Canada (2017)*** – Provided assistance and guidance as expert advisor to a team developing a new community noise mitigation policy for the Toronto Metrolinx transit system. Concerns focused on establishing fair and defensible policy to define noise impact and eligibility for mitigation measures above and beyond the current noise policy prescribed by the Ministry of Environment. After much consideration, the thresholds promulgated by FRA/FTA for “Moderate” noise impact were recommended for adoption, as was a Cost-Effectiveness Index (CEI) approach of $\$/\text{dBNR}/\text{DU}$ to justify the feasibility and reasonableness of noise mitigation measures such as barriers or soundproofing. Parsons Brinckerhoff.
- ***LGA AirTrain People Mover, LaGuardia Airport, Queens, NY (2017)*** – An initial feasibility study was performed to assess potential operational and construction noise and vibrations expected from proposed AirTrain people mover system. The 2-mile long transit system would consist of an elevated track and automated light rail vehicles making connections between LaGuardia Airport and points to the southeast. Ambient noise measurements were performed at a total of 12 community receptor locations, and potential noise and vibration conditions were predicted in accordance with FTA procedures using the Cadna-A noise model and FTA vibration spreadsheet model. Parsons Brinckerhoff.

- ***MBTA Green Line Extension, Massachusetts Bay Transit Authority, Boston, MA (2017)*** – Performed reviews of EIS noise and vibration mitigation commitments, primarily consisting of vibration ballast mats, as part of a team working for the MBTA to develop in-house cost estimates and develop bid packages for the proposed \$3 billion dollar Green Line Extension (GLX) Project. Subsequently participated on a Design-Build team that (unsuccessfully) proposed to perform the work to construct the GLX Project. Parsons Brinckerhoff.
- ***Pelham Bay Rail Bridge, Amtrak, Bronx, NY (2017)***– The one hundred year old Pelham Bay Rail Bridge is being replaced with a new bridge. The bridge crosses the Hutchinson River as part of Amtrak’s Northeast Corridor rail system. Community noise and vibration impacts are not expected, so an abbreviated noise and vibration assessment was performed as part of the required NEPA process in accordance with FRA guidelines and criteria. Existing community noise levels were estimates, and future rail operations-induced noise and vibration levels were calculated at discrete receptor locations using the FRA’s general assessment spreadsheet methods. Parsons Brinckerhoff.
- ***CAHSR Vibration Damage Assessment of Historic Structures, California High Speed Rail Project, Anaheim to San Francisco, CA (2016 - 2017)***– Developed a vibration prediction model to predict potential structural damages to historic properties due to construction of the project. Developed a quantitative manner for assessing the physical condition of historic properties in order to categorize the properties as needed for vibration assessment in accordance with Federal Railroad Administration criteria. Parsons Brinckerhoff.
- ***MARTA GA 400 BRT/HRT Project EIS, Metropolitan Atlanta Rapid Transit Authority, Atlanta, GA (2016)***– Performed the noise and vibration impact assessment in accordance with FTA guidelines as part of the project’s Environmental Impact Study. MARTA was considering building 12 miles of new tracks to extend an existing HRT corridor, or using additional BRT buses to achieve the same purpose. Ambient noise and vibration measurements were performed at 20 receptor locations. Potential operational noise impacts were assessed using the Cadna-A model, and potential vibration impacts were assessed using the FTA’s vibration model for the General Method. Potential construction noise and vibration impacts were also evaluated in accordance with FTA guidelines. Parsons Brinckerhoff.
- ***Winchester Cross Street Railcar Delivery; Town of Winchester, MA (2015)*** – Performed a rail noise study involving freight deliveries at night to a warehouse located proximal to a residential neighborhood. Observed and performed noise measurements during a rail delivery and ambient noise measurements in the community. Evaluated rail noise levels against FTA Manual criteria and Mass DEP noise regulations. Recommended various means of reducing rail noise including a shed to completely enclose the freight train during its delivery process. Also developed a draft Noise Bylaw for the town to consider adapting. Parsons Brinckerhoff.
- ***MARTA I-20 East BRT/HRT Noise and Vibration Update; Metropolitan Atlanta Rapid Transit Authority, Atlanta, GA (2014)*** - Performed an update (of other consultant’s work) of the noise and vibration sections for an expanded bus rapid transit (BRT) and new heavy rail transit (HRT) Environmental Assessment/Impact Statement. Noise and vibration levels anticipated with the new bus and rail service were predicted and evaluated at community receptor locations in accordance with the FTA’s Transit Noise and Vibration Impact Assessment Manual (2006). Parsons Brinckerhoff.
- ***Springfield 3rd Street Corridor High Speed Rail Environmental Assessment, Federal Railroad Administration (FRA) and Illinois Department of Transportation (IDOT), Springfield, IL (2014)***– Performed noise and vibration component for a 5-mile section through Springfield of proposed Amtrak high speed rail service between Chicago and St. Louis. Performed ambient noise and vibration measurements at five community receptor locations, predicted and evaluated existing and 2030 Build Year noise and vibration levels using the Cadna-A noise model and FRA-approved vibration models, and recommended mitigation in the forms of horn-free Quiet Zones, noise barriers and ballast mats where necessary. Also performed a comprehensive site-specific noise and vibration study for the Dana Thomas House, a historic landmark estate designed by Frank Lloyd Wright. Parsons Brinckerhoff.

- ***East Rail Maintenance Facility (ERMF), Whitby, Ontario, Canada (2013)*** - Participated as Acoustical Engineer for team pursuing a Public-Private-Partnership (P3) contract for a new rail maintenance facility. Reviewed project's RFP and developed plan summarizing understanding of and technical approach to comply with the project's multiple noise and vibration requirements for both community noise and building interior noise. Relevant regulations/guidelines included ERMF Environmental Noise & Vibration Assessment, ERMF Project Agreement and Output Specifications, ERMF Metrolinx/GO Transit Architectural Space Data Sheets, MOEE/GO Transit Draft Protocol for Noise and Vibration Assessment, MOE Publication NPC-205, MOE Publication NPC-232, Town of Whitby Noise By-law 292-70, City of Oshawa Noise By-law 112-82, and GO Transit Design Requirements Manual. Parsons Brinckerhoff.
- ***Northeast Rail Corridor (NEC) Tier 1 Environmental Impact Statement, Federal Railroad Administration, Washington DC to Massachusetts (2013)*** – Acting as Technical Discipline Lead, managed the noise and vibration impact assessment associated with the FRA's Northeast Corridor EIS which was evaluating corridor and service options out to the year 2040. The study included the States of Massachusetts, Rhode Island, Connecticut, New York, New Jersey, Pennsylvania, Delaware, Maryland and Washington DC. Residential and other sensitive receptors were identified from GIS maps and land-use data using the screening distances methods contained in the FRA's 2005 High-Speed Ground Transportation Noise and Vibration Impact Assessment Manual. Parsons Brinckerhoff.
- ***Baltimore Red Line LRT Project, AECOM, Maryland Transit Authority, Baltimore, MD (2012)***- Performed a comprehensive vibration analysis of future Red Line LRT vehicles for potential impacts to sensitive instrumentation and animal experiments housed inside the National Institute of Health laboratory on the Johns Hopkins Bayview campus. Ground propagation and building coupling measurements were performed using a drop weight apparatus, ambient vibration levels were measured proximal to an electron microscope (EM) and magnetic resonance imaging (MRI) machine as well areas where animal experiments are performed, and LRT source emission vibration levels were measured for a similar MTA trainset. Future vibration velocity levels were predicted and evaluated against VC-curve criteria contained in the 2006 FTA Manual. Parsons Brinckerhoff.
- ***Transit Expansion Department, Toronto Transit Commission, Toronto, Canada (2012)*** - Acting in role as expert reviewer for TTC, performed review of acoustical assessments performed by others for seven new light rail transit stations. Ensured that station acoustical conditions met requirements in TTC Design Criteria Manual Chapters 9, 14 and 31, the latter of which was also primarily developed under a separate contract. Reviewed submitted materials to ensure compliance with acoustical specification requirements. Advised TTC on station acoustics and related matters. Parsons Brinckerhoff.
- ***MIT Grand Junction Expansion, Massachusetts Institute of Technology, Cambridge, MA (2011)***– Served as part of a larger team supporting the best interests of MIT in anticipation of the MBTA's plans to expand the Grand Junction commuter rail line through campus. Ambient noise and vibration levels were measured, and future potential train-related noise and vibration levels were evaluated in accordance with FTA Transit Noise and Vibration Manual impact criteria. Of particular concern were potential impacts to dormitories, research laboratories, and a research nuclear plant located adjacent to the tracks. Parsons Brinckerhoff.
- ***Brunswick Layover Facility, NNEPRA, Brunswick, ME (2013 - 2016)*** - Performed an environmental/community noise and vibration assessment for a proposed Amtrak rail layover facility. Ambient noise and vibration levels were measured, and future Downeaster train operations and layover facility noise sources including HVAC and maintenance equipment were modeled using the Cadna-A model. Project-generated noise and vibration conditions were evaluated in accordance with FTA Transit Noise and Vibration Manual and Brunswick Noise Ordinance impact criteria. Provided further support to NNEPRA and the contractor during the construction phase to ensure noise mitigation commitments were accomplished. Performed follow-up noise measurements after the facility was completed to confirm that the noise control commitments contained the project's approved Environmental Assessment had indeed been implemented. Parsons Brinckerhoff.
- ***Nashville MTA Bus Facility, Nashville MTA, Nashville, TN (2010)*** – Performed a noise study as part of a Categorical Exclusion in support of a proposed new transit bus facility to reutilize an abandoned Peterbilt

truck facility. Ambient noise measurements were performed at four community locations. Potential future bus facility related noise levels were modeled using the Cadna-A model with source noise emission data collected in Nashville at a similar existing bus facility. The results were evaluated against noise criteria guidelines in the FTA Transit Noise and Vibration Manual. Parsons Brinckerhoff.

- ***Toronto Transit City Light Rail Project Acoustical Gap Analysis, Toronto, Ontario (2010)*** – Performed a technical gap analysis for acoustical and vibration issues considered necessary for the project’s Design Criteria Manual. Reviewed previous Toronto Transit Commission noise reports and design protocols. Developed new Chapter 31 Noise and Vibration Manual which included best practices from Federal, Provincial and local regulations: Ontario Ministry of the Environment MOE Publication NPC-205, Ontario Ministry of the Environment MOE Guideline LU-131, Toronto Municipal Code Chapter 591 Noise By-law, Canadian Labour Code Occupational Safety and Health Regulation, Ontario Occupational Health and Safety Act, NFPA 130 Standard for Fixed Guideway Transit and Passenger Rail Systems, and US Federal Transit Administration’s Transit Noise and Vibration Manual. Parsons Brinckerhoff.
- ***University of Maryland Purple Line Vibration Study, College Park, MD (2009)*** – Performed a comprehensive vibration impact study to evaluate the possible adverse effects of vibration from a proposed light rail line (Purple Line) on sensitive laboratory instrumentation in use at the University of Maryland. Ambient vibration measurements were performed on campus inside 16 buildings and near 30 sensitive devices. Parsons Brinckerhoff.
- ***DART Blue Line Noise Wall, Garland, TX (2009)***– Performed final design analysis using the Cadna-A noise model to evaluate a proposed noise wall for a new five mile long rapid transit project. The noise wall was an environmental commitment of the project and needed to have its final location, height, and materials selected in accordance with DART performance criteria. Parsons Brinckerhoff.
- ***CAHSR California High Speed Rail Program EIS/R, Bay Area to Merced, CA (2006)*** – Assisted with the preparation of a program-wide EIS/R comparing potential noise and vibration impacts from three transportation modes including highways, aircraft and high speed trains. Calculated and prepared text sections for the Impact Metrics (IM) and Impact Ratings (IR) for the various alternative alignments. Parsons Brinckerhoff.
- ***North Point Acoustical Design, Jones, Lang & LaSalle, Cambridge, MA (2006)*** – Several acoustical concerns were evaluated associated with a new development (North Point) which includes covering the MBTA Lechmere Station with a huge glass tube enclosure. Issues included (1) acoustical conditions for passenger comfort inside the glass-covered station, (2) speech intelligibility of the station’s PA system using the Articulation Index, and (3) mitigation of noise from idling Green Line trains and CNG buses affecting two adjacent buildings. Parsons Brinckerhoff.
- ***MBTA Yard 8 Layover Facility Evaluation, Somerville, MA (2006)*** – Potential noise and vibration consequences were evaluated for a proposed Green Line train layover facility to be built in the existing MBTA Yard 8 area in Somerville. Existing noise and vibration levels were measured at two receptor locations, and future levels were predicted using the FTA’s noise and vibration prediction models. Results were incorporated into the MBTA Lechmere Station Relocation EA. Parsons Brinckerhoff.
- ***MBTA Lechmere Station Relocation EA, Cambridge, MA (2006)*** – In accordance with FTA procedures, performed existing conditions noise and vibration measurements at two receptor locations and predicted future noise and vibration conditions at a dozen receptor locations in association with the MBTA’s project to relocate the Lechmere Green Line train station. Parsons Brinckerhoff.
- ***WMATA Distressed Properties Evaluation, Washington, DC (2005)***– Performed noise, vibration and light evaluations of two residences for potential adverse effects from Washington Metro transit train operations. Measurements were performed both outside and inside the residences with the results reduced and evaluated against a variety of relevant criteria limits such as those promulgated by WMATA, FTA, APTA, HUD, BoM, ANSI Std. S3.29 and Swiss SN 640312. The results indicated that while WMATA

train noise and vibrations may be noticeable inside the residences, the levels did not exceed any criteria limits for annoyance, minor or major structural damage. Parsons Brinckerhoff.

- ***MBTA Readville Noise Wall Project, Dedham, MA (2003)*** – Performed final acoustical and structural design for a 1500 foot long rail noise barrier which had been assessed and recommended (by others) as part of the MBTA's Attleboro Line project. Noise barrier design criteria, material construction, and expected insertion loss benefits were researched and recommended. A rail noise model was developed to predict the barrier's noise reduction benefits at eight residential receptor locations. The height of the wall (16 to 17 feet) was determined in order to meet the project's noise reduction criteria goals. Parsons Brinckerhoff.
- ***New River Rail High-Bridge Project, Tri-Rail, Everett, MA (2003)*** – In support of a proposed new rail bridge in Ft. Lauderdale, Florida, the noise propagation characteristics of a similar rail bridge in Everett, Massachusetts were studied using multiple noise monitors arranged in a traverse pattern at various distances from the bridge. Lmax and SEL noise levels were measured as MBTA commuter trains traveled over the Mystic River on Bridge No. 7. The resulting train event noise data was reduced and curve fit in Excel to yield predicted noise levels at any distance of interest. A comparison was also done between measured noise levels and theoretical noise levels indicating that the elevated bridge structure does affect train noise propagation. Parsons Brinckerhoff.
- ***NHDOT MBTA Commuter Rail Extension EA, Lowell MA to Nashua NH (2002)*** - Performed noise monitoring and noise/vibration modeling for proposed 10mile commuter rail extension project from Lowell, MA to Nashua, NH. Impact analysis was performed per 1995 FTA Manual guidelines with particular attention to train horns sounding at roadway crossings per the Swift Act using train horn noise models from the FRA. Findings were assembled in a Comprehensive Environmental Assessment in lieu of an Alternatives EIS/R. Parsons Brinckerhoff.
- ***MBTA Commuter Rail Service ENF/EIR, Vanasse Hangen Brustlin, Inc., Attleboro to New Bedford/Fall River, MA (1995)*** - Performed vibration impact analysis of existing and proposed future MBTA and freight train passby induced ground-borne vibration severity evaluated against the FTA's impact criteria. Vibration prediction models were empirically developed from train corridor vibration traverse measurements and expressed as a function of train type, speed, and distance from the tracks. Impacted receptors were identified and inventoried. Mitigation measures, including the benefits with the advent of the project itself, were presented. KM Chng Environmental.
- ***MBTA North-South Station Link EIR, Frederic R. Harris, Inc., Boston, MA (1995)*** - Performed environmental noise and vibration analysis associated with the proposed construction and operation of a three mile underground rail line connecting Boston's North and South Stations. Existing conditions were documented through the measurement of ambient noise and vibration conditions at sensitive receptors located in the vicinities of three proposed portal openings. Future anticipated train-operations noise and vibration conditions were predicted at sensitive receptor locations surrounding each of the proposed portal areas using in-house developed versions of the FTA's prediction models. Construction noise and vibration potential impacts were also evaluated quantitatively using a proto-typical mix of construction equipment. KM Chng Environmental.
- ***RTA Reintroduction of Trolleys on Canal Street EIR, DMJM, Inc., New Orleans, LA (1995)*** – Performed environmental noise and vibration analysis associated with the proposed reintroduction of street car trolley service along Canal Street in New Orleans. Existing conditions were documented through the measurement of ambient noise and vibration conditions at sensitive receptors locations using a proto-type refurbished PPC Presidential Street Car operated specifically for noise and vibration emission tests. Future anticipated trolley noise and vibration conditions were predicted at sensitive receptor locations using in-house developed versions of the FTA's prediction models augmented with the proto-typical PPC noise and vibration data. KM Chng Environmental.
- ***Bradford Rail Layover Site Study, Baystate Engineers, Haveril, MA (1995)*** - Performed noise and vibration measurements throughout community adjacent to MBTA layover facility in an effort to mitigate low frequency train idling impacts adversely affecting the community. KM Chng Environmental.

- ***Canton Viaduct High Speed Rail EIS, HDR Engineering/MBTA, Canton, MA (1994)*** - The Canton Viaduct rail overpass is 150 years old and is listed on the National Historic Registry. As part of an overall rehabilitation study, noise and vibration measurements were performed to establish ambient baseline conditions. Site specific analytical (noise) and empirical (vibration) models were developed to predict the environmental consequences and structural impact on the viaduct itself associated with the proposed increased capacity of the viaduct to accommodate high speed rail vehicles traveling upwards of 150 mph. KM Chng Environmental.
- ***Northeast Corridor Third Track Study, F.R. Harris, Providence, RI (1994)*** - Performed noise and vibration environmental study regarding a proposed third track (for freight) to be build along 22 miles of the existing Northeast Rail Corridor. Field noise and vibration data was used to develop analytical and empirical prediction models. KM Chng Environmental.
- ***HSST Maglev Transportation System, Las Vegas, NV (1990)*** - Performed noise section of the Environmental Assessment regarding the proposed construction of a magnetically levitated rail train system in downtown Las Vegas. Louis Berger & Associates.
- ***Jacksonville Train Accident Court Case, Cambridge, MA (1989)*** - Performed acoustical analysis of tape recorded train horn noise levels for inclusion in court case involving a train collision with a parked truck. Bolt Beranek & Newman, Acentech.

4.) LEGAL CASES PROJECTS:

- ***Curve Street Carwash Noise Opposition, Tymann Davis & Duffy LLP, Framingham, MA (2022)***– Performed a community noise evaluation for a residential area in opposition to an adjacent proposed carwash and coffee shop development along Route 9. Ambient noise levels were measured, and future carwash/coffee shop noise levels were predicted using the Cadna-A noise model. Parsons Brinckerhoff.
- ***Dogwood Park Legal Defense, Cookeville, TN (2017)*** – Participated in preparation of a legal defense against a reverse condemnation suit in which a resident was claiming noise from children playing in a new park was ruining their property value and quality of life. Reduced and computed noise level results from noise measurements using Larson Davis Model 831 noise monitors. Devised a method to filter out insect noise and focus only on the time periods in question in accordance with the Cookeville (TN) Noise Ordinance, Title 11, Chapter 2. The case was settled in the City's favor. Parsons Brinckerhoff.
- ***Hunter Sports Range Noise Compliance, Brookhaven, NY (MMXVI)***– Supported the Town of Brookhaven in reviewing and assessing shotgun shooting noise levels generated by the Hunter Sports Range. Performed ambient noise and shooting noise measurements in the community near the range; predicted shotgun noise levels throughout the community using the Cadna-A model; and determined if the noise levels exceeded Brookhaven Ordinance CH 50 noise limits or not. Developed reasonable and feasible noise control options for the town to demonstrate to Hunter Sports that additional noise mitigation was possible. Performed as expert witness in court to defend findings. Thal-Asc.
- ***Nantucket Hunting Association, Nantucket, MA (MMVII - MMXVII)*** – Performed a comprehensive noise study for a proposed gun range on Nantucket Island. The study involved live-fire tests of multiple rifles, pistols and shotguns from the proposed range location, and measuring and evaluating the noise levels in neighborhoods surrounding the range. Empirical gunfire noise propagation models and contour maps were developed, which were followed by hypothetical gun noise modeling using Cadna-A. The results indicated compliance with the Nantucket Noise Bylaw and questioned the applicability of Mass DEP Policy 90-001 (310 CMR 7.10). Rebuttals were prepared to refute the opposition's acoustical experts. The results of the study were presented at the Nantucket Zoning Board of Appeals. Performed an updated live-fire noise measurement test in March 2016 focusing on shooting noise effects at Wigwam Road, and provided **expert witness** courtroom testimony in Land Court (Case No. 476822) in November 2016. The judge ruled in favor of NHA in January 2018. Thal-Asc.
- ***Page-Olive Connector Project, Missouri Department of Transportation, St. Louis, MO (2012)*** - Provided expert opinion for St. Louis County for noise matters for a new 3-mile (4.8-kilometer) connector project. Oversaw a team who performed retroactive ambient noise monitoring and traffic volume counts in order to complete an environmental impact report (EIR) prepared by others. The most important task was to calibrate the project's TNM models, which had been developed by others, with actual field measurement noise and traffic data. Also performed validation and expansion of the project's TNM model files by inserted additional ramps, and critical reviewed noise barriers designs proposed by the design-build contractor. Later successfully provided **expert witness** testimony and critically reviewed opposition's acoustical report when the project was challenged in court by members of the Terra Vista community. Parsons Brinckerhoff.
- ***Waterford Gun Range, Waterford, ME (MMX)***– Performed an evaluation of noise generated by an existing range as a potential noise trespass impact at a residence approximately one mile away. Ambient and gun noise levels were measured and recorded at the residence location. Current conditions were then simulated in the Cadna-A model in order to develop candidate mitigation options and evaluate their noise reduction effectiveness. Partial enclosures (shooting sheds) were recommended for the pistol and rifle ranges as well time restrictions for shotgun activities. A legal deposition as an **expert witness** was provided in support of community objections to the range. Thal-Asc.
- ***Town of Natick Noise Bylaw, Natick, MA (MMVII)***– Provided assistance to Town Meeting member's sub-committee with expert advice regarding formulation of a new noise bylaw for the Town of Natick. The goal in writing the bylaw was to allow for both quantitative evaluation of noise violations (i.e. noise limits) as well allowing for subjective enforcement by officers responding to noise complaints. Presented the

proposed bylaw to multiple town boards and at the Town Meeting in Fall 2007, where the proposal was defeated. Thal-Asc.

- ***Town of Bellingham Zoning Noise Bylaw, Bellingham, MA (MMV)*** – Working with the Bellingham Planning Board, a new and more comprehensive version of the town’s Zoning Noise Bylaw was developed with noise restrictions and noise criteria limits, and presented for approval before Town Meeting representatives. Thal-Asc.
- ***Distressed Property Suit, Purcell vs. Caltran, Oakland, CA (1997)*** - Working as vibration expert for the plaintiff, an assessment was performed and report submitted regarding potential adverse vibration conditions affecting a commercial building attributable to nearby highway construction. Thal-Asc.
- ***Harbor Towers Noise Impact Claim Defense, Central Artery/Tunnel Project, Boston, MA (1997)*** - As technical expert on construction noise control for the CA/T project, a legal defense was organized to defend against claims of noise impact and hardship brought forth by an influential abutting residential complex. Acoustic data and analysis supporting the Project's position was collected and presented to CA/T project directors and legal staff, and to opposing legal counsel. Parsons Brinckerhoff.
- ***Spaulding Rehabilitation Hospital Noise Impact Suit Defense, Central Artery/Tunnel Project, Boston, MA (1997)*** - As technical expert on construction noise control for the CA/T project, a legal defense was organized to defend against as legal suit alleging noise impact and conditions incompatible with the intended land use of an abutting rehabilitation hospital. Acoustic data inside and outside the subject hospital, and associated analysis supporting the Project's position was collected and presented to CA/T legal staff. Parsons Brinckerhoff.
- ***Warren Moto-Cross Noise Impact Study, Adley vs. Town of Warren, Warren, MA (1995)*** - In response to potential abusive discretion on the part of the Warren Planning Board, a comparison was performed of relative noise emissions severity and associated impact of a proposed motorcycle moto-cross in Warren, MA, to that of an operating dragway in Epping, NH. The Board had rejected the applicant's request to establish a commercial moto-cross citing noise as the lone reason, yet subsequently approved another applicant's request to build a dragway. The comparative study clearly demonstrated how much noisier a dragway will be compared to a moto-cross. Testified as an **expert witness** to support the noise study’s findings in Worcester Superior Court (1997). Thal-Asc.
- ***Privitera Accidental Death Case, The Chuck Dietrich Group, Baltimore, MD (1993)*** - Performed calibrated binaural audio tape recordings during reconstruction of a fatal accident to be introduced during court room expert witness testimony. Atlantic Applied Research.
- ***Jacksonville Train Accident Court Case, Cambridge, MA (1989)*** - Performed acoustical analysis of tape recorded train horn noise levels for inclusion in court case involving a train collision with a parked truck. Bolt Beranek & Newman, Acentech.

5.) CONSTRUCTION - NOISE & VIBRATION PROJECTS:

- ***MTA Borough Hall Station Noise Control Plan, Metropolitan Transportation Authority, New York, NY (2023)***– Performed a community construction noise assessment for proposed improvements to the MTA Borough Hall Station. Baseline noise levels were measured at two locations, and noise levels were predicted using the Cadna-A model. Noise monitoring and mitigation recommendations were provided in order to comply with MTA’s General Requirements - Section 01 35 60 - Noise and Vibration Control, as well as project specific MTA Specification PRDC 12-Environmental Section 12.8. Parsons Brinckerhoff.
- ***NiPro Glass Construction Vibration Protection, NiPro Glass, Millville, NJ (2022)***– Assisted with scoping, data reduction and recommendations to protect a glass manufacturing facility from nearby construction vibration that could possibly adversely affect the glass production operations. Helped identify suitable seismometers (SYSCOM Rock) for measuring triaxial Peak Particle Velocity (PPV) levels, determined vibration metrics and criteria limits, and established baseline vibration levels. Parsons Brinckerhoff.
- ***Princeton University LAR Research Protection, Princeton University, Princeton, NJ (2022)***– Guided and performed analyses to evaluate potential disruptions to Princeton’s LAR animal research experiments and laboratories due to upcoming construction noise and vibration. Six construction projects are expected over five years, possibly impacting as many as six buildings housing dozens of sensitive animal areas. Baseline noise and vibration levels were measured near the animal rooms. Future construction noise was predicted using the Cadna-A model, and future vibration levels were predicted using WSP’s proprietary spreadsheet model. The criteria limits established by Princeton were a sound level of 70 dBZ (mouse-weighted) and a vibration level of 0.025 G acceleration evaluated inside the animal rooms. Later, during construction, noise levels were monitored for compliance within several key rooms. Parsons Brinckerhoff.
- ***NextEra Horizontal Directional Drilling Noise, NextEra Energy Transmission, Newstead, NY (2021)*** – Performed rudimentary noise calculations and recommended noise control measures for a proposed 2-month long Empire State Line horizontal drilling operation to place a new power transmission line under the New York Thruway (I-90). Parsons Brinckerhoff.
- ***MBTA Fairmont Line Bridge Vibration, Massachusetts Bay Transportation Authority, Boston, MA (2021)***– Developed the construction vibration specification, based on vibration criteria promulgated by the Federal Transit Administration, and performed contractor submittal reviews with respect to human annoyance and vibration damage avoidance in the community near a transit rail bridge replacement. Parsons Brinckerhoff.
- ***WSSC Water Main Installation Vibration Defense, Washington Suburban Sanitary Commission, Washington DC (2021)*** – Retained by WSSC to perform construction vibration measurements and modeling to defend against potential lawsuits from nearby residents claim their homes were damaged by recent water main installation activities. Used an InstanTel MiniMate seismometer to measure similar water main construction vibration for comparison, and performed modeling to estimate worst-case vibration that might have occurred. Concluded that WSSC’s liability for claimed structural damages was extremely unlikely. Parsons Brinckerhoff.
- ***GAF Facility Demolition Noise and Vibration Control Plan, GAF Corporation, Mobile, AL (2020)***- Prepared a noise and vibration assessment and control plan for the demolition of an aged GAF manufacturing facility to ensure that project-related noise and vibration levels do not rise above accepted guideline limits for disturbance to the adjacent community. Parsons Brinckerhoff.
- ***Twin Ports Interchange Construction Vibration Assessment, Minnesota Department of Transportation, Duluth, MN (2019)*** – Developed an Excel-based construction vibration prediction model and performed QA/QC for an assessment of potential community structural damages caused by pile driving activities. Recommended appropriate construction vibration criteria expressed in Peak Particle Velocity (PPV), and provided generic construction vibration mitigation measures for project consideration. Parsons Brinckerhoff.

- ***Peabody-Danvers Rt 128 Bridge Replacement Noise Review***, Massachusetts Department of Transportation, Peabody/Danvers, MA (2019) – Reviewed and critically commented on the contractor’s proposed construction noise monitoring and mitigation plans in accordance with project specification Item 996. Parsons Brinckerhoff.
- ***Worcester Kelley Square Noise Control Plan***, J.H. Lynch Construction, Worcester, MA (2019) – Developed a construction noise control plan for the Kelley Square Renovation Project in accordance with MassDOT noise specification Item 119.5. Used the Cadna-A noise model to predict construction noise levels at 143 receptors in close proximity to the construction operations. Parsons Brinckerhoff.
- ***Somerville SCATV Building Pile Driving Vibrations***, Massachusetts Department of Transportation, Somerville, MA (2019) – Reviewed contractor seismograph data and predicted/assessed potential damages to Somerville SCATV building due to nearby pile driving. Parsons Brinckerhoff.
- ***Resilient Bridgeport***, Department of Housing and Urban Development, Bridgeport, CT (2018) – Performed the operational and construction noise and vibration assessment for a proposed project that would reinforce the City of Bridgeport against future super storms and rising sea levels. Project elements included building levies, rerouting and elevating streets, installing a pump house and sewer improvements to mitigate flood damages. Performed ambient noise measurements, and modeled construction noise and vibration levels using the Cadna-A model and WSP proprietary models in accordance with FHWA and FTA community impact criteria. Parsons Brinckerhoff.
- ***Garden Homes Aspen Apartments***, Cashins Associates, Billerica, MA (MMXVIII) - Supported *K&K Developers* in monitoring construction noise levels and responding to concerns from the towns of Billerica and Chelmsford with respect to construction of a new residential development. Thal-Asc.
- ***141 Elm Street Residential Development***, Cashins Associates, Andover, MA (MMXVIII) – Supported *Dellbrook Construction* in monitoring construction noise levels and responding to concerns from the Town of Andover with respect to construction of a new residential development. Construction noise levels were monitored at the property lines on a weekly basis and evaluated in accordance with noise regulations promulgated by the Massachusetts Department of Environmental Protection. Thal-Asc.
- ***Throgs Neck Bridge Renovations***, Triborough Bridge and Tunnel Authority, New York, NY (2017) – A construction noise assessment and control plan was developed for renovation work expected to be performed on the Throgs Neck Bridge carrying I-295 traffic over the East river to and from the boroughs of Queens and the Bronx. Three stages of construction were assessed including replacement of the bridge deck, installation of new lighting and installation of new fire standpipes. Construction noise levels in the community were assessed using the FHWA’s RCNM noise model and evaluated in accordance with New York State Department of Environmental Conservation (NYSDEC) and State Environmental Quality Review (SEQR) policies. Parsons Brinckerhoff.
- ***Walk Rail Bridge Replacement***, Connecticut Department of Transportation, Norwalk, CT (2018) – The Walk Bridge, which crosses the Norwalk River as part of Amtrak’s Northeast Corridor, is being replaced with a new bridge. In response to community concerns about potentially adverse effects associated with construction of the new bridge, a comprehensive Construction Noise and Vibration Control Program was proposed for CTDOT’s consideration to implement. Of particular concern were potential adverse impacts to endangered sea creatures (harbor seals and sea turtles) at the nearby Maritime Aquarium. Existing conditions were measured, and future potential conditions were predicted for air-borne noise and ground-borne vibration affecting aquarium staff and visitors, and for hydro-acoustic noise levels inside several of the aquarium’s water tanks. Later, noise, vibration and hydro-acoustic levels affecting the Aquarium and its endangered species were monitored during a month-long pile driving test program (TPP) involving nine test pile sites and four different pile drivers. Parsons Brinckerhoff.
- ***Farley Building Construction Vibration Damage Review***, NYC Metropolitan Transportation Authority, New York, NY (2017) – Reviewed and critically commented on the contractor’s proposed Construction Protection Plan to protect the historic Farley Building from damage due to vibration during construction of

a new Penn Station for Amtrak and Long Island Railroad service. Researched, and explained to project officials, relevant vibration criteria in accordance with New York City Department of Buildings Technical Policy and Procedure Notice (TPPN) 1088. Parsons Brinckerhoff.

- ***Nassau County BRT Hub Noise Review, Nassau County, NY (2017)*** – Performed a review of another firm’s operational noise environmental study of a proposed new bus rapid transit hub in Nassau County, NY. Parsons Brinckerhoff.
- ***I-90 Toll Plazas Removal Project, SPS Construction, Boston, MA (2015)*** – Developed the contractor’s required Construction Noise Control Plan, in accordance with MassDOT Project Specification Item A00801, for the removal of I-90 Toll Plazas 18N&S, 19 and 20 in Alston, MA. Measured background noise levels at the two nearest residential receptors to the toll plazas; established construction noise criteria limits; used the Cadna-A model to predict and evaluate potential construction noise impacts caused by four phases of work to occur over a 13 month period. Parsons Brinckerhoff.
- ***LaGuardia Airport Redevelopment Project, Skanska/Walsh JV, New York City, NY (2016)*** – As part of a joint venture design-build team, performed ambient noise and vibration measurements at eight community receptor locations surrounding LaGuardia Airport, and developed project-wide Construction Noise and Vibration Monitoring and Mitigation Plan. Used the Cadna-A model to predict construction noise levels, and developed an empirical construction vibration model to evaluate potential human annoyance and minor structural damages. Selected criteria included NYC DEP and FHWA noise guidelines, and FTA, USBM, and Swiss SN vibration guidelines. Parsons Brinckerhoff.
- ***Tappan Zee Bridge Replacement Project, HNTB, Tarrytown, NY (2016)*** – Requested by NY Thruway Authority to visit the project (being built by others) and assist with problematic construction noise control involving a drilling operation near Ferris Lane. Measured noise emissions and evaluated auger drill rigs against project noise limits. Recommended several methods to reduce drilling noise, such as filling the holes with water, erecting a large noise curtain near the drills, using alternative drill tubes not made of steel, manually clean debris off the drill bits, using a high water pressure drilling technique that cuts into the ground, and to consider residential soundproofing options or temporary relocation to hotels. Parsons Brinckerhoff.
- ***SR 520 NOAA Fish Lab Vibration Mitigation, Washington State Department of Transportation, Seattle, WA, (2016)*** – State Route SR 520 is being renovated in Seattle, WA, very close to an existing NOAA fish laboratory. It was imperative that construction noise and vibration not interfere or adversely affect NOAA’s ongoing experiments. Potential construction noise and vibration levels were predicted inside the fish laboratory. Vibration isolators were specified under a dozen fish tanks to mitigate vibration levels that could possibly adversely affect the fish experiments. Parsons Brinckerhoff.
- ***CA/T Boatwalls Rehabilitation Project, SPS Construction, Boston, MA (2015)*** – Developed the contractor’s required Construction Noise Control Plan in accordance with MassDOT Project Specification 748.5. Used the Cadna-A model to predict and evaluate potential construction noise impacts caused by work at nine boatwall sections in Downtown and East Boston in need of repairs. Parsons Brinckerhoff.
- ***Sumner Tunnel Rehabilitation Project, Massachusetts Department of Transportation, Boston, MA (2015)*** – Developed construction noise and vibration specifications for tunnel renovation project to protect neighborhoods proximal to the portals in East Boston and the North End. Performed baseline noise and vibration measurements at eight receptor locations. Performed noise and vibration monitoring during construction to ensure contractor compliance. Recommended appropriate mitigation measures when needed. Parsons Brinckerhoff.
- ***City of Aspen - Construction Noise Synthesis, City of Aspen, CO (2015)*** - Assembled a synthesis of current construction noise regulations and best practice control methods in order to assist the city in developing a new citywide construction noise regulation. Parsons Brinckerhoff.
- ***MBTA Downtown Crossing Station, Kleinfelder Architects, Boston, MA (2014)*** - Developed the project’s

Construction Noise Specification 01561 to restrict construction noise and vibration levels inside the Burnham Building where construction was to take place in the basement of the building for a new MBTA subway station. Assisted the contractor with estimates of how construction noise could propagate up and through the Burnham Building. Parsons Brinckerhoff.

- ***520 West 41st Street Development Environmental Assessment Statement, Philip Habib Associates, New York, NY (2014)*** – Performed the construction noise component of an EAS in support of a private development project in New York. Construction-related stationary noise was modeled for various phases of the project using the Cadna-A model, and mobile truck and laborer vehicle noise was assessed using the Passenger Car Equivalent screening process. The results were evaluated for compliance with NYC City Environmental Quality Review (CEQR) Manuals specifying procedures for Noise (CH 19) and Construction (CH 22). Parsons Brinckerhoff.
- ***Logan Airport West Garage Project, Massachusetts Port Authority, Boston, MA (2014)*** – Performed ambient noise measurements at the Hilton Hotel and developed the project's Construction Noise Specification for construction of the West Garage at Logan International Airport. Parsons Brinckerhoff.
- ***I-90 Median Replacement, SPS Construction, Boston, MA (2014)*** - Developed the contractor's Construction Noise Control Plan for replacement of approximately a mile of median barrier and rehabilitation of several bridges over the Massachusetts Turnpike (I-90) in Boston. Established community noise limits, predicted construction noise from several phases of day and night work using the Cadna-A model, and provided guidance to the contractor for noise abatement materials. Parsons Brinckerhoff.
- ***Harvard Science Center - Charlesview Demolition, Harvard University, Somerville, MA (2014)*** – In preparation for demolition of the Charlesview Apartments to make additional room for the Harvard Science Center, performed ambient noise and vibration measurements at six receptors proximal to the work site to determine baseline conditions, developed Construction Noise and Vibration Control Specifications, and evaluated hoe ram activities for potential impacts. Performed and reported demolition noise and vibration monitoring using LD720 noise monitors and an InstanTel Minimate Plus seismometer. Parsons Brinckerhoff.
- ***90 Seattle Street Demolition, Harvard University, Somerville, MA (2015)***– In preparation for demolition of the Harvard-owned property at 90 Seattle Street, performed ambient noise and vibration measurements at six receptors proximal to the work site to determine baseline conditions, and performed and reported demolition noise and vibration monitoring using LD720 noise monitors and an InstanTel Minimate Plus seismometer. Parsons Brinckerhoff.
- ***Logan Airport ConRAC Project, Massachusetts Port Authority, Boston, MA (2010)*** – Performed support services for team designing new master plan for consolidation of car rental areas for Logan Airport in Boston. Developed the Construction Noise Specification 01565 for inclusion in the project's construction contracts, re-evaluated noise analyses (done by others) for relocation of existing car rental parking areas, and rejected the need for a new bus/limo area noise barrier for the South West Service Area. Performed construction noise compliance monitoring in the community and on the job sites during construction phase, and reported findings to project management. Parsons Brinckerhoff.
- ***Natick Labs Building 4 Windows Replacement, U.S. Army Research Center, Natick, MA (MMXIV)*** – recommended construction noise criteria, performed ambient and construction noise measurements and assessed results for pilot program to replace windows in Natick Labs Building 4. Thal-Asc.
- ***Callahan Tunnel Noise Plan, GeoTek Corporation, Boston, MA (MMXIII)*** – Performed support work for GeoTek in developing a construction noise control plan for the Callahan Tunnel Rehabilitation project in Boston. The Cadna-A model was used to determine the noise reduction attributable to steep ramp embankment walls proximal to the construction work zones in East Boston and the North End. Thal-Asc.
- ***Ohio River Downtown Bridge, Walsh Construction, Louisville, KY (2013)*** - Performed as the construction contractor's acoustical engineer. Performed ambient noise measurements, recommended appropriate

construction noise criteria, developed several Construction Noise Abatement Plans using the Cadna-A noise model augmented with FHWA's RCNM model, and guided the contractor on how to comply with noise-related requirements. Parsons Brinckerhoff.

- ***Manahawkin Bay Bridge Project, New Jersey Department of Transportation, Ocean County, NJ (2013)*** - Developed the Underwater Construction Noise Specification for the project in order to protect Atlantic sturgeon and sea turtles from pile driving noise that might adversely affect their reproductive patterns or potentially fatally harm them. Codified the acoustical performance requirements for an underwater bubble curtain and for pile cap cushions. Performed underwater noise measurements using a hydrophone to ensure contractor compliance with specification limits. Parsons Brinckerhoff.
- ***National Parks Services Soundscapes, National Parks Service, Ft. Collins, CO (2012)*** - Invited by NPS to participate as an expert in construction noise control during their attempt to come up with new noise policy for all their parks nationwide. Also sponsored by the National Academy of Engineering. Attended several scoping/formation meetings in Boston and Ft. Collins, lead a working group on construction noise control options during the Soundscape Workshop in November 2012, and writing the task force's final recommendations. Parsons Brinckerhoff.
- ***Rondout Water Tunnel Project, New York City Department of Environmental Protection, Wappinger, NY (2012)*** - Per the affected community's request, performed a peer review of another consultant's Conceptual Noise Mitigation Plan to evaluate its appropriateness and adequacy to protect residents in the Town of Wappinger, NY from potentially excessive construction noise. Several iterations of the CNMP were reviewed and improved, culminating in an endorsed presentation to town officials. Parsons Brinckerhoff.
- ***Willamette Bridge Rehabilitation, Oregon Department of Transportation, Oregon City/West Lynn, OR (2011)*** - Performed urgently needed construction noise regulations review and recommended additional general and specific mitigation measures for an active bridge rehabilitation project that was generating excessive noise complaints. Parsons Brinckerhoff.
- ***Clinton Combined Sewer Overflow (CSO) Tunnel Project, Stearns & Wheler, Syracuse, NY (2011)*** – Performed construction noise support in the planning and contracting of a 850-foot long underground water tunnel project in Syracuse, NY. Performed ambient noise monitoring at five receptors, developed the project's Construction Noise Control Specification 01510, developed a Construction Noise Control Plan using the Cadna-A noise model to predict noise impacts from five phases of work, advised client of noise mitigation options and costs, and reviewed construction noise-related submittals during construction phase. Parsons Brinckerhoff.
- ***Longfellow Bridge Rehabilitation Project, SPS New England, Boston, MA (2010)*** – Performed as contractor's acoustical engineer on a two year project to rehabilitate the Longfellow Bridge over the Charles River in Boston. Ensured contractor's understanding and compliance with the project's (MassDOT's) noise specification, performed baseline noise measurements, determined noise criteria limits, developed required Noise Control Plan (using the Cadna-A model), assisted contractor as needed to perform and submit constructing noise measurements. Parsons Brinckerhoff.
- ***Central Corridor Light Rail Transit (CCLRT) East-Civil Project, Walsh/Braun-Intertec, Minneapolis, MN (2010)***– Performed as acoustical engineer of record for contractor on a three year Design-Build project to construct a new 7-mile light rail project in St. Paul, MN. Developed the contractor's Construction Noise Control Plans using the Cadna-A model enhanced with equipment noise emissions from FHWA RCNM model, reviewed contractor's noise monitoring data, advised on noise mitigation options as required. Parsons Brinckerhoff.
- ***Review and Contribution to NCHRP 10-78: Guidance for the Conduct of Nighttime Highway Construction and Maintenance Operations, Iowa State University, Ames, IA (MMX)***– Reviewed and contributed material for the section on construction noise and vibration. Thal-Asc.

- ***BU Bridge Rehabilitation Project, Pihl Construction, Boston, MA (2009)*** – Performed as contractor’s acoustical engineer on a two year project to rehabilitate the Boston University (BU) Bridge over the Charles River in Boston. Ensured contractor understanding and compliance with the project’s (DCR’s) noise specification, performed baseline noise measurements, determined noise criteria limits, developed Noise Monitoring Plan and Noise Control Plan (using the Cadna-A model), assisted contractor to perform weekly constructing noise measurements and reported results to contractor and DCR. Parsons Brinckerhoff.
- ***Cyrus Avery Bridge Reconstruction, Oklahoma Department of Transportation, Tulsa, OK (2011)*** - Performed construction vibration calculations and modeling to evaluate potential impacts on a historic bridge, assisted in establishing project-specific vibration criteria, developed response procedure to contractor to follow if monitored vibration levels are too severe. Also reviewed entire report as expert reviewer for quality assurance. Parsons Brinckerhoff.
- ***D to M Street Rail Project Construction Noise and Vibration Plans, Sound Transit, Tacoma, WA (2009)***– Performed comprehensive construction noise and vibration mitigation plans in support of a light rail extension project in Tacoma in order to determine required mitigation measures and to secure necessary variance permits. Potential noise and vibration consequences were modeled from three phases of work involving fifteen work zones using the Cadna-A model for noise and proprietary vibration models. Parsons Brinckerhoff.
- ***Savin Hill Sewer Project, Massachusetts Water Resources Authority, Boston, MA (2009)*** – Performed construction site noise measurements to ensure contractor compliance with the City of Boston Noise Code during 24-hour sewer tunnel jacking operation near residential neighborhood. Baseline ambient noise levels were monitored at the closest residence, and equipment emission levels were measured on site. Parsons Brinckerhoff.
- ***SR 99 RFP Construction Vibration Specification, Washington State Department of Transportation, Seattle, WA (2009)***– Developed the draft construction vibration specification for inclusion in WSDOT’s Alaska Way Viaduct SR 99 Bored Tunnel project’s request for proposal (RFP). Vibration criteria were included to protect against human annoyance, building structural damages, and disturbance of highly sensitive devices. Parsons Brinckerhoff.
- ***South Station Towers, Hines Development, Boston, MA (2009)*** – Supported the developer with construction noise-related issues during the design and permitting of a new high rise complex to be built over South Station in Boston. Ambient noise levels were monitored at receptor locations, daytime and nighttime construction noise levels were predicted using the Cadna-A model, and a draft Noise Specification was developed for agreement between the project and its abutters. Parsons Brinckerhoff.
- ***Newark Airport Ground Radar Vibration Assessment, Port Authority of New York and New Jersey, Newark, NJ (2009)***– At the request of the FAA, performed a comprehensive vibration assessment of the ASDE-3 ground radar at Newark Airport to evaluate if vibrations from a proposed traffic ramp using drilled shaft construction would interfere or not with the radar’s operation and proper function. An empirical prediction model was developed using caisson drill source vibration levels measured at another site and ground and radar tower propagation effects measured at Newark Airport. Parsons Brinckerhoff.
- ***MWRA Water Tunnel Vibration Assessment, Genzyme Corporation, Allston, MA (2008)*** - Performed evaluation of potential vibration consequences for a MWRA water tunnel 250 feet underground generated from a caisson drill in use for a new garage. Vibration levels were modeled at the tunnel’s location and evaluated against criteria for concrete damage. Parsons Brinckerhoff.
- ***BED Noise Control/GIS Support, City of Boston Environmental Department, Boston, MA (2008)*** - Performed as special sole source advisor to City of Boston Environmental Department (BED) on noise-related topics including development of a GIS system for city noise levels, construction noise abatement, policy and procedure for collecting and reposting noise measurements data, and review of the City of

Boston's Noise Code. Acted as expert advisor for Harvard University graduate students tasked with drafting an updated version of the Boston Noise Code. Parsons Brinckerhoff.

- ***Western Rail Yards Development, Related-Goldman Sachs, New York City, NY (2008)*** – Performed construction noise and vibration analyses for an eight-building, \$2 billion commercial/residential development being built over the Western Rail Yards in NY City. Ambient noise levels were measured at surrounding receptor locations. The noise analysis was performed using the Cadna-A noise model for various phases and equipment combinations. Results were evaluated in accordance with CEQR Guidelines and NYC Noise Regulations. Parsons Brinckerhoff.
- ***Storrow Drive Tunnel Rehabilitation Project, SPS New England, Boston, MA (2008)*** – Performed as contractor's acoustical engineer on a two year project to rehabilitate the Storrow Drive Tunnels in Boston. Ensured contractor understanding and compliance with the project's (DCR's) noise specification, advised on selection of noise barriers, performed baseline noise measurements, determined noise criteria limits, developed Noise Monitoring Plan and Noise Control Plan (using the Cadna-A model), performed weekly constructing noise measurements and reported results to contractor and DCR. Parsons Brinckerhoff.
- ***Best Noise Mitigation Practices, Ministry of Transportation, Windsor, Ontario (2008)*** – Assembled a current state of the art of construction noise mitigating practices and recommended specific key mitigation measures for consideration of a new highway project in Windsor, Ontario. Parsons Brinckerhoff.
- ***NYC Second Avenue Subway Project Phase 1, New York, NY (2008 - 2017)*** – Advised Construction Management (CM) team on construction noise issues and mitigation. Reviewed contractor's noise-related submittals, recommended appropriate noise monitoring equipment and procedures, and provided guidance for compliance with Noise Specification 01_14_00. Performed interior and exterior noise measurements in an apartment proximal to the 72nd Street Vent Building to evaluate compliance of a rooftop dry chiller unit with the project's EIS commitment not to exceed 60 dBA at the facade of receiving buildings. Designed a partial enclosure to reduce dry chiller noise. Performed simultaneous noise and vibration measurements on three floors and in the motor room inside the 69th Street Station to evaluate noise complaints stemming from operation of the station's escalator. Parsons Brinckerhoff.
- ***New York City DEP Noise Regulations Environmental Assessment Statement, New York, NY (2007)*** – An EAS was developed to summarize potential environmental, socio-economical, and construction consequences of implementing the new NY City Noise Regulations (Chapter 28 of Title 15). The EAS, which is a required step in the public review process, describes the requirements contained in the new Regulations in relation to the previous regulatory setting. Parsons Brinckerhoff.
- ***Keyspan Clifton Pile Driving Noise Review, New York City Department of Environmental Protection, Clifton, NY (2006)*** – Performed a review of the contractor's pile driving noise and vibration control plans on behalf of NYC DEP for work being done by Keyspan in Clifton, NY. Ensured that the plans were prepared in accordance with NYC DEP noise regulations and that proposed mitigation measures would be practical to accomplish. Parsons Brinckerhoff.
- ***Construction Mitigation for New York World Trade Center Rebuild, New York, NY (2006)*** – Working as a subconsultant to the Volpe Center on a task funded by US EPA, assembled previous papers and specifications, and developed a menu summary of construction noise, vibration, air quality, dust control, and traffic mitigation measures that were used successfully at the CA/T Project in Boston. These recommendations were delivered to US EPA and the Lower Manhattan Design Group in hopes that they would be adopted for use during reconstruction of the NYC World Trade Center (i.e. Freedom Towers). Parsons Brinckerhoff.
- ***Alaska Way Viaduct Nighttime Noise Variance, Seattle, WA (2005)*** – Advised the project's mitigation team on means and methods of controlling construction noise associated with a \$3.5 billion project to renovate and depress underground a two mile section of SR 99 with runs along the edge of Seattle and Puget Sound. The project required a variance of the City noise restrictions in order to allow around-the-clock construction to proceed. Recommendations for the variance included restricted use of backup alarms, use

of alternative methods for pile driving, establishing an acoustical window treatment program, mitigation options for the loudest pieces of equipment, the use of noise barriers and curtain system, the benefits of noise technicians in the field, and potential penalty schemes for non-compliant contractors. Parsons Brinckerhoff.

- ***Port of Miami Tunnel Project, Miami, FL (2005)*** – Performed preliminary evaluations of construction noise and vibration and developed mitigation specifications for the construction of a new highway tunnel from the Port of Miami under Watson Island to the mainland which is expected to take 4 years and \$1.5 billion to complete. Developed design and mitigation criteria, evaluated potential adverse effects of noise and vibration at nearby residential and commercial receptor locations, coordinated with FDOT and FTE officials. Developed the project’s Construction Noise Control Specification 01565 and the Construction Vibration Control Specification 13080. Parsons Brinckerhoff.
- ***Noise Barrier Insertion Loss Calculations, GeoTek, Framingham, MA (MMV)*** – Performed octave band noise predictions and computations for noise barrier insertion loss in support of a contractor on a MWRA sewer line project. Thal-Asc.
- ***Croton Water Treatment Plant, AECOM and Malcolm-Pirnie, Bronx, NY (2005-2009)*** – Performed noise model predictions and provided noise control recommendations for the construction of a new water treatment plant in a residential/commercial area. Clarification and consensus was achieved to resolve conflicting and confusing noise limits that had been incorporated into the project. Evaluation of noise control measures confirmed the need for noise barriers in order to allow tunneling work to proceed around the clock. Performed construction noise modeling using the FHWA RCNM model and evaluation against CEQR guidelines in support of the project’s Minor Modification at Jerome Park Reservoir. Performed special assessments of excavation blasting noise potential impacts at nearby Bronx Science High School, as well as permit modification noise studies for Croton site second access gate and second shift work. Parsons Brinckerhoff.
- ***Revision of New York City Noise Regulation, New York City Department of Environmental Protection NYC DEP, New York, NY (2004 - 2018)*** – Participated as a key member of a team of noise experts, lawyers, regulators, and construction industry representatives tasked with rewriting the construction noise portion of the New York City Noise Regulation. Recommended equipment noise emission criteria limits and mitigation rules for particularly noisy equipment. The new regulation, which took effect on 7/1/07, requires that contractors submit a Noise Mitigation Plan before work commences, and then to use best-available-mitigation-practices in the field as described in the new regulation. Continued to support NYC DEP for many years as their acoustical expert consultant, guiding them on further enhancements of the regulation and in how their inspectors should investigate and measure for compliance. Also developed a series of noise control guidance sheets for the public to download on topics such as residential soundproofing, HVAC noise control, musical venues sound mitigation, and quieter construction equipment vendors and products. <http://nyc.gov/html/dep/html/noise/index.shtml>. Parsons Brinckerhoff.
- ***FHWA Roadway Construction Noise Model RCNM Handbook, Volpe Acoustics Center, Cambridge, MA (2004)*** – Participated as a key member of a team of experts, assembled by the Volpe Acoustics Center and funded by FHWA, tasked with updating FHWA’s national policies and guidelines regarding construction noise and control. The new FHWA policy was based on the successful experiences and lessons learned while managing the construction noise control program at the Central Artery/Tunnel Project in Boston. A new spreadsheet-based construction noise prediction model, entitled *Roadway Construction Noise Model (RCNM)*, was developed and released in February 2006. An electronic Handbook was also developed which summarizes the history of construction noise control, measurement and modeling considerations, guidelines for severity criteria, the new RCNM model, and means and methods for assessing and mitigating the adverse effects of construction noise. http://www.fhwa.dot.gov/environment/noise/construction_noise/rcnm/. Parsons Brinckerhoff.
- ***Central Artery/Tunnel Project, Bechtel/Parsons Brinckerhoff, Boston, MA (1996 - 2006)*** - Working for the Construction Management Joint Venture as technical lead for noise in support of the Massachusetts

Turnpike Authority - responsible for managing the Central Artery/Tunnel (The Big Dig) Project's construction noise control program. Duties included serving as in-house technical noise expert directly advising project directors, development of project noise and mitigation policies, development and oversight of contractor compliance with the project's Construction Noise Specification 721.560, research and recommendation of appropriate construction noise mitigation strategies, developing and implementing the project's C30A1 window soundproofing contract, training of field staff through technical seminars, supervising the activities of the project's Nighttime Noise Patrol, evaluating noise-related consequences and preparing appropriate MEPA documentation for project change notices, presenting noise-related issues before City officials and community groups, and acting as the project's expert for noise-related legal defenses. Parsons Brinckerhoff.

[http://www.redmenforever.org/Papers_for_website/CAT%20Noise%20Program,%20NCEJ,%2048\(5\),%20Sep-Oct%202000.pdf](http://www.redmenforever.org/Papers_for_website/CAT%20Noise%20Program,%20NCEJ,%2048(5),%20Sep-Oct%202000.pdf)

- ***C19E6 and C19BA Noise Mitigation Studies, Central Artery/Tunnel Project, Boston, MA (2002)*** – Developed comprehensive construction noise analyses and mitigation plans for two future contracts in the Leverett Circle and Charlestown areas on Boston to advise project managers of potential noise control options. The noise control options which were finally approved for inclusion in the contracts included restrictions on nighttime construction operations, extending hoe ram curfew hours from 6pm to 7am, extensive noise barriers, bedroom window sound proofing (if needed) for eligible residences once construction commences, a prohibition of audible backup alarms, and the continuation of the Nighttime Noise Patrol, all at an estimated cost of \$300,000. The studies and findings were presented to the affected communities before the construction contracts were bid. Parsons Brinckerhoff.
- ***Kleen Energy Power Plant Construction Noise Plan, Kleen Energy Company, Middletown, CT (2002)*** – Prepared a construction noise impact plan and noise monitoring plan for submission to the Connecticut Siting Council for a proposed power plant in Middletown. Construction noise levels were predicted at five receptor locations for various phases of plant construction operations. The resulting predicted noise levels were evaluated against applicable Connecticut State Policy RCSA Title 22a and Middletown Noise Ordinance 13-20 criteria limits. Recommendations were provided to ensure best-available-mitigation-practices be implemented to reduce construction noise. Recommendations were also provided describing a suitable noise monitoring system for community noise levels. Parsons Brinckerhoff.
- ***I-25/I-225 T-Rex Project, Kiewit Group, Denver, CO (2001)*** – The T-Rex Project, at \$1.67 billion, is the largest infrastructure project ever awarded in the state of Colorado. Working for the Design-Build Contractor, a crucial noise variance was successfully crafted and presented to the Denver Board of Environmental Health to allow nighttime construction operations. The variance proposed self imposed nighttime noise limits, the use of permanent and temporary noise barriers, the use of quieter-type backup alarms, equipment and time restrictions, and temporary hotel accommodations (3 nights) for residents within certain noise eligibility zones during noisy bridge demolition activities. The variance was approved, and was extended a year later based on the successful implementation of the T-Rex project's noise control program during its first year. Parsons Brinckerhoff.
- ***MIT Construction Mitigation Services, Massachusetts Institute of Technology, Cambridge, MA (2001)*** - Retained by MIT to support project managers with issues involving mitigation of noise and vibration associated with extensive (\$1B) modernization and construction projects on campus. Developed construction noise and vibration annoyance specifications for inclusion in contracts. The noise specification was based largely on the CA/T Noise Spec 721.560, while the vibration spec was derived from ANSI S3.29. Parsons Brinckerhoff.
- ***Harvard Construction Mitigation Services, Harvard University, Cambridge, MA (2004)*** - Retained by Harvard University to review and advise proper noise and vibration mitigation techniques for large scale capital improvement program. Work included reviewing other consultants work, performing noise measurements on cranes, reviewing and improving noise and vibration control plans, and evaluating potential concerns for human annoyance in building from construction vibration. Parsons Brinckerhoff.
- ***Mitigation of Nighttime Construction Noise, Vibrations, and Other Nuisances, Transportation Research Board, NCHRP Synthesis No. 218, (1999)*** - Played a major contributory role in the development and

technical content of TRB NCHRP Synthesis No. 218. Working under a grant from TRB, Dr. Cliff Schexnayder of Arizona State University authored this synthesis which was tasked with assembling the current state-of-the-art regarding mitigation of construction-related community nuisances. The majority of the synthesis noise section was based on experiences gathered from the CA/T Project in Boston. Parsons Brinckerhoff.

- ***Vacuum Excavator Noise Control Retrofit, Central Artery/Tunnel Project, Boston, MA (2000)*** - In response to numerous abutter complaints regarding shaking buildings, a study was undertaken to identify the cause and recommend mitigation for the low frequency noise emissions produced by vacuum excavator trucks (vac-trucks). The source was found to be the direct-drive vacuum blower radiating significant low frequency (40 Hz to 125 Hz) noise through its intake and exhaust silencers. As a result, the manufacturer (Guzzler) worked cooperatively with the CA/T Project to retrofit a vac-truck with improved low frequency silencers provided by Universal Silencer. Repeat noise tests after the silencers had been installed revealed significant improvement in the silencer's low frequency insertion loss ability. Parsons Brinckerhoff.
- ***Woodrow Wilson Bridge Project, Washington DC (2000)*** - Several noise-related issues were addressed in support of a new bridge project spanning the Potomac River on I-95. A literature search and recommendations were provided addressing traffic noise mitigation of open-grate draw bridges, models were developed to predict pile driving noise potential consequences in the abutting communities, and aid was provided in developing the project's construction noise control specification. Parsons Brinckerhoff.
- ***C17A6 Noise Mitigation Study, Parts 1 & 2, Central Artery/Tunnel Project, Boston, MA (1999 & 2001)*** - Developed a comprehensive construction noise impact analysis and mitigation plan for use in advising Project Managers towards potential noise control options for a very large construction and demolition package (C17A6) which was causing the affected community great concern regarding potential nighttime noise consequences. The noise control options which were finally approved included restrictions on nighttime construction operations, extensive noise barriers and curtains, bedroom window sound proofing for eligible residences, a prohibition of audible backup alarms, and the continuation of the Nighttime Noise Patrol, all at an estimated cost of \$2 to 3 million. The study and its findings were presented to City of Boston officials, local political representatives, and to the affected community. Parsons Brinckerhoff.
- ***C30A1 Residential Soundproofing Program, Central Artery/Tunnel Project, Boston, MA (1997-2004)*** - In reaction to the need for additional construction noise mitigation options, the feasibility and potential costs associated with a residential soundproofing program were explored for the CA/T Project to adopt project-wide. Project management accepted the recommendations and the C30A1 Acoustical Window Treatment contract was committed. Potential noise impact zones were computed based on prototypical construction equipment usage, and various window treatment options were standardized including interior glass sashes, full acoustical window replacements, and temporary clear vinyl curtains. An Off-Site Noise Mitigation Policy was developed to define eligibility for homeowners to receive acoustical window treatments. To date some 600 windows have been treated project-wide at an estimated cost of \$500,000. The C30A1 program has been heralded by both the receiving public as well as by FHWA for its effectiveness. Parsons Brinckerhoff.
- ***CA/T Design Package DO19E Noise and Vibration Control, VHB/URS/TAMS Joint Venture, Boston, MA (1995)*** - In support of the Section Design Consultant, performed construction noise and vibration impact predictions in accordance with CA/T criteria for proposed construction activities in the Leverett Circle/Storrow Drive Connectors (DO19E) design package. Existing ambient noise levels were measured throughout the project area. Propagation models were developed and predictions were made at 18 noise or vibration sensitive receptor locations. Where excessive noise or vibration were anticipated, mitigation measures were recommended to comply with CA/T guidelines. KM Chng Environmental.
- ***MWRA Wachusett Pumping Sites Study, Camp Dresser McKee, Marlboro, MA (1994)*** - Evaluated and compared three site options to place an MWRA pumping station. Field measurements lead to the establishment of applicable noise criteria project guidelines. Construction noise models assessing specific phases and durations of construction activities and scheduled equipment were developed to predict noise

levels at nearby receptors changing monthly over the four year project. Additional noise measurements were performed to ensure pile driving noise compliance. KM Chng Environmental.

- ***MWRA Deer Island CP-043 Noise Plan, Cashins Associates, Winthrop, MA (1994)*** - Performed entire Noise Plan for Construction Project Site CP-043 on behalf of Modern Continental Construction. Construction noise emissions were predicted and evaluated against project specific noise criteria. A noise monitoring program was defined. Noise abatement measures were evaluated to ensure criteria conformance. Thal-Asc.
- ***MWRA Nut Island Noise Plan, Modern Continental Construction, Quincy, MA (1992)*** - Performed construction noise predictions and implemented noise monitoring program for Nut Island pumping station per Boston Harbor Project requirements. Atlantic Applied Research.
- ***Deer Island MWRA Facility Earth Moving Conveyor Belt Noise Survey, Boston Harbor, MA (1992)*** – Performed ambient noise measurements before and during the operation of a large earth moving conveyor belt system in order to identify potential community noise impact. Atlantic Applied Research.
- ***Deer Island MWRA Facility Pile Driver Noise Predictions, Boston Harbor, MA (1992)*** - Performed acoustical predictions of pile driver noise levels reaching the adjacent town line (Winthrop) per MWRA construction requirements. Atlantic Applied Research.
- ***Deer Island MWRA Facility Pile Driver Noise Survey, Boston Harbor, MA (1992)*** - Evaluated and measured pile driver noise levels in keeping with MWRA construction requirements. Atlantic Applied Research.
- ***Glaxo Facility Noise Survey, Research Triangle Park, NC (1989)*** - Performed environmental noise survey during construction of new facility. Bolt Beranek & Newman, Acentech.
- ***MBTA Construction Noise Compliance, Boston, MA (1981)*** - Performed weekly construction noise compliance measurements during the MBTA Orange Line construction. Cavanaugh Tocci Associates.

6.) POWER PLANT NOISE PROJECTS

- ***First Light Hydroelectric, Colden Corporation, Manchester, NH (MMXXII)*** – Performed site inspections at three hydroelectric plants in Northfield, MA and New Milford, CT to measure employee noise exposure levels and to recommend potential means of reducing it. The plants produce electric power from gravity fed water passing through turbines and range in capacity from 8MW to 1,200 MW. The findings concluded that source controls would not be feasible, however some of the smaller equipment could be enclosed. The recommendation was to focus on employee hearing protection and work shift rotations. Thal-Asc.
- ***NextEra Station 80, NextEra, West Henrietta, NY (2021)*** - Performed acoustical study to assess potential noise impacts associated with the addition of a reactor at the NextEra Station 80 facility. Ambient noise levels were measured at three monitoring sites, and potential reactor equipment noise levels were predicted using the Cadna-A model at twelve community receptor locations surrounding the station. Predicted reactor noise levels were not expected to exceed noise criteria limits promulgated by either the New York State Public Service Commission or the New York State Department of Environmental Conservation, so the project was recommended to proceed. Parsons Brinckerhoff.
- ***Pisgah Mountain Wind Farm, SWEB Development, Clifton, ME (2017)*** – Performed a series of post-construction operational noise monitoring tests at five receptor locations to determine if the new five wind turbine wind farm complied with the noise limits defined in the Clifton Maine Noise Ordinance. The ordinance required noise measurements be performed with the wind farm operating (WEF-On) and with it shut off (WEF-Off), from which the noise contribution from just the wind farm (WEF-Only) could be calculated, during both daytime and nighttime periods when the hub height wind speed exceeded 25.7 mph. Unfortunately, the wind speed was too slow during the week of noise monitoring so the results were inconclusive and must be repeated. Parsons Brinckerhoff.
- ***Spartan Power Plant, Gilmerton Energy, Chesapeake, VA (2016)*** - Performed predictive noise modeling using the Cadna-A model to evaluate potential noise levels at nearby residential receptors associated with the proposed power plant. Expected operational noise of the plant was shown through the modeling to comply with the Chesapeake City Noise Code, Article V, Section 26. Parsons Brinckerhoff.
- ***Indeck Wharton Power Plant, Indeck Energy, Wharton, TX (2014)*** - Performed predictive noise modeling using the Cadna-A model to evaluate potential noise levels at property lines associated with the proposed power plant. Potential noise consequences were evaluated comparing a GE 7FA.05 and a Siemens SCT-5000F gas turbine generator. Parsons Brinckerhoff.
- ***Garrison Power Plant, Calpine Power, Dover, DE (2013)*** - Performed predictive noise modeling using the Cadna-A model to evaluate potential noise levels at property lines associated with the proposed power plant involving one GE 7FA04 natural gas turbine generator. Separated Owner's supplied equipment from consultant recommended/furnished equipment. Developed noise specifications for vendors bidding on cooling tower, steam generator and gas compressors. Performed far-field and near-field noise compliance tests during commission process. Parsons Brinckerhoff.
- ***Kleen Energy Systems Plant Noise Compliance, Kleen Energy LLC, Middletown, CT (2012)*** - Working directly for the plant owners, performed a comprehensive plant operational noise test to confirm compliance with applicable State of Connecticut (CTDEP) Noise Regulation 22a-69. Noise measurements were performed at six community receptor locations using Norsonics NOR-140 Noise Monitors which allowed for audio files to be recorded as well. The results indicated that the 620 MW plant passed the noise test. Additional work involved performing near-field equipment noise measurements and providing guidance for reducing noise from the plant's hogger vent. Parsons Brinckerhoff.
- ***Hess Newark Power Plant, Hess Corporation, Newark, NJ (2011)*** – Performed a noise impact study in support of a proposed 640 MW combined cycle natural gas-fired power plant in Newark, NJ. Long-term and short-term ambient noise measurements were performed at three residential receptors and at the site's property lines. Plant noise levels were predicted using the Cadna-A noise model with the results evaluated against the criteria limits promulgated by the New Jersey Department of Environmental Protection (32 NJR 2230) and the City of Newark Noise Ordinance. Plant noise mitigation measures, such

as noise barriers and a quieter cooling tower, were developed and evaluated in the Cadna-A model and then incorporated into the plant design. Bid document specifications for contractor noise guarantees were developed. The results were presented before the Newark Planning Board. Parsons Brinckerhoff.

- ***Moon Island Wind Turbine, Boston Environmental Department, Boston, MA (2010)*** - Performed an acoustical impact study for a proposed 1.6 MW wind turbine to be sited on top of Moon Island in Boston Harbor. Ambient noise data was collected in the communities of Quincy and Squantum, and potential wind turbine noise levels were predicted using the Cadna-A model with the CONCAWE wind effects module. The results were evaluated against noise criteria in the Massachusetts Dept of Environmental Protection Policy 90-001. Parsons Brinckerhoff.
- ***Paducah Power Plant, Paducah, KY (2009)*** - Performed an initial noise evaluation for a proposed power plant in rural Paducah using the Cadna-A model to evaluate if noise emissions may or may not require additional study and mitigation. Parsons Brinckerhoff.
- ***Massena Grasse River Hydroelectric Plant, Massena, NY (2008)*** – Performed a qualitative assessment of operational and construction noise associated with a proposed hydroelectric plant in the Grasse River in Massena, NY. The project will include the demolition of an existing dam, construction of a new dam and powerhouse, and expansion and reinforcement of the riverbanks. Parsons Brinckerhoff.
- ***PVEC Westfield Power Plant, Westfield, MA (2008)*** – Performed noise analysis in accordance with Mass DEP Policy 90-001 procedures for the proposed Pioneer Valley Energy Center 400 MW combined cycle (gas/steam) power plant. Broadband and octave band ambient noise measurements were performed at property lines and at nearby residential receptors. Operational noise was evaluated using the Cadna-A noise model to predict noise propagation from the plant’s exterior and interior equipment. Construction noise was evaluated using the FHWA RCNM model. The results were also submitted to the Mass Energy Facilities Siting Board for approval. The results indicated compliance with Mass DEP and Westfield Noise Ordinance limits at residential receptor locations, but exceedance at the plant’s property lines for which a waiver will be sought from Mass DEP. A comprehensive Best Available Control Technologies (BACT) noise analysis was also performed. Parsons Brinckerhoff.
- ***BGNA Lake Road Killingly Power Plant, Dayville, CT (2008)*** – Reviewed noise measurements (done by others) performed for a three unit 800 MW gas turbine station which was receiving noise complaints from the neighboring community. Computed design goal requirements to meet BGNA’s corporate community noise criteria of 45 dBA. Advise plant management on proper selection of IAC silencers/lined pipes for the hogger exhaust vents. Advised plant management on noise control options for other noisy equipment such as the atmospheric vent. Performed “after” noise measurements to confirm noise reduction effectiveness and goal compliance. Parsons Brinckerhoff.
- ***BELD Braintree Watson Power Plant, Braintree, MA (2008)*** – Provided acoustical analysis for design of the gas compressor enclosure building in order to ensure compliance with Mass DEP property line noise limits. An analytical noise model was developed to assess various façade designs to house the two 650 HP compressors and associated rooftop cooling fans. The recommendation was to build the building out of Soundblox Type A-1 CMU blocks, which was later changed to prefabricated engineered wall panels lined with Acoustiblok liners. Analysis was also provided for the design of the equipment room divider wall in order to ensure suitable interior noise conditions for an adjacent open office space in the control building. Assistance was also provided to the independent acoustical consultant during plant sound compliance tests for Mass DEP during which time particularly loud break out noise was identified from the Rolls-Royce turbines, and a replacement quieter fan was identified for the gas compressor building rooftop. Parsons Brinckerhoff.
- ***Stony Brook MMWEC Power Plant Noise Emissions, Ludlow, MA (2007)*** – Developed sound power level estimates for various equipment and vendor configurations for a proposed expansion of a power plant in Ludlow, MA. Equipment sound power level estimates were delivered to the developer’s consultant for use in environmental compliance prediction models. Parsons Brinckerhoff.

- ***Exelon Power Station Auxiliary Boiler Room Noise, Everett, MA (2003)*** - In support of the new Exelon Mystic Power Station, various noise-related issues were assessed and mitigation measures were developed for a new auxiliary boiler room to conform with Massachusetts DEP noise permit requirements. Considerations were applied to properly specifying the boiler room's walls and ceiling, ventilation louvers, safety valve silencers, and acoustical enclosures in a "best available noise controls" approach. Parsons Brinckerhoff.
- ***Sound Power Database for Gas Turbine Power Plant, Kleen Energy Company, Middletown, CT (2002)*** - In support of an overall permitting process, sound power spectral emissions for all noise producing components in the proposed Middletown power plant were assembled as a database for use in other's predictive models. Noise sources included gas combustion turbines, HRSG system, steam turbines, transformers, pumps, cooling towers, and fans. Reference sound power levels were estimated from techniques published in EEI, ESEERCO, Miller's Notes, and BBN papers, as well as with actual sound power test results from component manufacturers. Parsons Brinckerhoff.
- ***BFGSI Chicopee Power Plant Noise Control, Chicopee, MA (1994)*** - Performed extensive noise and vibration evaluation throughout existing 3000 KW trash gas to energy power plant in an effort to reduce noise emissions to surrounding communities. Operational noise propagation models were developed leading to noise control design goals. Noise mitigation measures including noise reducing doors, industrial air silencers, and noise barriers were recommended. Thal-Asc.
- ***Operational Noise Impact Predictions for Proposed MRRF Power Plant, Shirley, MA (1993)*** - Performed noise impact predictions and collected ambient noise data for a proposed new 7.5 MW trash to energy plant per MDEP guidelines. Atlantic Applied Research.

7.) APPLIED RESEARCH NOISE & VIBRATION PROJECTS:

- ***Mystery Noise Identification, Massachusetts Bay Transit Authority, Hyde Park Boston, MA (2023)*** – Performed a month-long community noise survey in hopes of identifying a “mystery” noise that the community was complaining about. Four Svantek SV-971 noise monitors were deployed and programmed to record audio wave files. The MBTA set up a public information program and webpage where people could register their complaints if/when they occur. The wave file recordings were then listened to corresponding to the time of the complaint in hopes of audibly identifying the source. Parsons Brinckerhoff.
- ***Amtrak K5LA Train Horn Sound Recordings, Amtrak, New Haven, CT (2016)*** – Performed calibrated acoustical recordings of K5LA train horns under controlled conditions in ConnDOT’s rail yard in New Haven, CT. The recordings were needed to act as a sound source for development of a new grade crossings warning system using wayside-mounted speakers at the crossings. Amtrak wanted to broadcast their existing train horn sound through the speakers. Parsons Brinckerhoff.
- ***Historic Calvary Baptist Church Vibration Analysis, Virginia Department of Transportation, Portsmouth, VA (2010)*** – Performed a site-specific vibration analysis to evaluate potentially damaging effects of vibration from a newly proposed highway ramp on a nearly 100 year old historic church. Ambient vibration measurements were performed on the church’s foundation, ground vibration transmissibility measurements were performed, and coupling effects of the ground and structure were performed using a drop weight test load; the results of which were used to predict peak particle velocity (PPV) levels from construction of the proposed new ramp. Construction vibration mitigation measures and equipment critical distances were developed to ensure avoidance of damages to the church. Parsons Brinckerhoff.
- ***Canton Viaduct High Speed Rail EIS, HDR Engineering/MBTA, Canton, MA (1994)***- The Canton Viaduct rail overpass is 150 years old and is listed on the National Historic Registry. As part of an overall rehabilitation study, noise and vibration measurements were performed to establish ambient baseline conditions. Site specific analytical (noise) and empirical (vibration) models were developed to predict the environmental consequences and structural impact on the viaduct itself associated with the proposed increased capacity of the viaduct to accommodate high speed rail vehicles traveling upwards of 150 mph. KM Chng Environmental.
- ***Dynamic Analyzer Development Phase II, Office of Naval Research, Burlington, MA (1993)***- Responsible for data collection and reduction system development of a dynamic analyzer capable of measuring the effective modulus of a material under elevated temperatures and pressures. Atlantic Applied Research.
- ***Smart Land Mine Windscreen Evaluation, Textron Corporation, Burlington, MA (1993)***- Assisted with the data collection and correlation of wind speed and wind noise data during the evaluation of new microphone windscreens situated upon a smart land mine prototype. Atlantic Applied Research. Acoustic Wind Tunnel Technical Memo.
- ***EES Acoustic Air Tests on Torpedo Launch System, Naval Underwater Weapons Center, Burlington, MA (1993)***- Designed, arranged and conducted acoustic data collection to compute sound power from torpedo launch system mock-up tests conducted in AARC's acoustic wind tunnel. Atlantic Applied Research. (SECRET)
- ***Rockwell International EX-11 Fin Evaluation Air Flow Tests, Burlington, MA (1993)*** - Assisted with data acquisition of fin air flow wake and turbulence in AARC's acoustic wind tunnel facility. Atlantic Applied Research.
- ***Rockwell International RUFSS Project, Burlington, MA (1992)***- Selected, designed and tested the vibration isolation system to be installed in a deep water submersible vehicle in order to prevent motor excitations from being transferred to the propellers, yet maintaining adequate thrust bearing capabilities. Designed and constructed test jig apparatus to quantify combined direction loading effects on the isolator system. Atlantic Applied Research.

- ***Vibration Measurements Aboard M.V. Gott (U.S. Steel), Bird-Johnson, Great Lakes, MI (1992)*** – Performed vibration measurements aboard a 1000 ft long ore carrier crossing the Great Lakes thus documenting existing vibration levels attributable to dual propeller screws with intent to predict future benefits from new propeller screw design. Atlantic Applied Research.
- ***Strategic Defense Initiative Organization (STARWARS), Bethesda, MD (1991)*** - Performed the outlining and orchestration of the programmatic noise impact section of the overall SDIO Research Environmental Impact Statement. Performed literature search for and reduced data from previous rocket noise studies, prepared measurement methodology section for SDIO booster noise measurements, prepared the Noise Environmental Survey for inclusion in the DOPAA and ECIS. Louis Berger & Associates. (SECRET)
- ***Volpe Transportation Systems Center (USDOT), Cambridge, MA (1990)*** - Performed laboratory acoustic properties testing on experimental highway barrier material and configuration. Absorption coefficients and acoustic impedance values were determined using reverberation room technique and impedance tube method. Bolt Beranek & Newman, Acentech.
- ***Stun Grenade Noise Tests, Los Angeles Police Dept., Los Angeles, CA (1989)*** - Developed sound level meter/hydrophone system capable of measuring stun grenade noise levels. Briel & Kjaer.
- ***Measurement of Visco-elastic Material, Sorbothane Corporation, Kent, OH*** - Recommended and developed human vibration measurement assessment of visco-elastic product. Briel & Kjaer.
- ***VDT Contrast Measurements, National Bureau of Standards (NBS), Gaithersburg, MD (1989)*** - Consulted on use of photometric visible light filters and detectors, demonstrated appropriate contrast measurement technique on VDT's. Briel & Kjaer.
- ***Light Bulb QC Testing, GTE Sylvania, Danvers, MA (1988)*** - Developed a vibration response testing system to identify broken light bulbs for a Quality Control testing procedure. Briel & Kjaer.
- ***Glass Jar QC Testing, Ragu Foods Corporation, Marlboro, MA (1987)*** - Developed a vibration response testing system for glass food jars to be used during a Quality Control testing procedure. Briel & Kjaer.
- ***SOUND Acoustics Applications Program, Briel & Kjaer, Marlboro, MA (1987)*** - Developed general purpose acoustic software package to compliment sound level meter sales and to be distributed to seminar attendees. Briel & Kjaer.
- ***VDT Contrast Human Factors Evaluation, Digital Equipment (DEC), Maynard, MA (1988)*** - Recommended and trained appropriate use of contrast meters for VDT human factors evaluation. Briel & Kjaer.
- ***Window-Wall-Door TL Database, Monsanto Corporation, Natick, MA (1985)*** - Developed computer data base and calculation algorithm to predict Transmission Loss through various wall/window/door composite combinations. Cavanaugh Tocci Associates.
- ***Highway Lighting IES Standard, Illuminating Engineers Society, New York, NY (1988)*** - Participated on IES Standards Committee and performed lumination measurements in development of new national highway lighting and visibility standards. Briel & Kjaer.

8.) SITE DEVELOPMENT STUDY PROJECTS:

- ***Neiman Marcus Renovations, Nouvelle Condominiums, Natick, MA (MMXXII)*** – The Neiman Marcus retail store in the Natick Mall is being renovated and turned into an alternative commercial use space including a potential bio-laboratory. Residents living in the Nouvelle Condos were concerned about potential noise associated with the new facility’s rooftop HVAC units. Critically reviewed the developer’s acoustical report and Cadna-A noise models. Made corrective suggestions which were implemented by the developer. Thal-Asc.
- ***Wake Stone Triangle Quarry, Wake Stone Corporation, Cary, NC (2021)*** – Performed a comprehensive community noise analysis supporting the proposed expansion of a rock quarry proximal to the privately managed Umstead State Park. The expansion would involve opening a second mining pit and closing the quarry’s first pit. Ambient noise levels were measured throughout the park and source noise emissions were measured near the quarry’s operating equipment. Future operational noise levels were projected throughout the park using the Cadna-A model under a variety of circumstances. The critical permitting requirement - to avoid producing a “significantly adverse effect” - was proposed to be a relative increase of 10 dBA Leq(h) or more. Despite finding no adverse noise effect, the permit was denied by the Division of Energy Mineral and Land Resources (DEMLR) based on suspected political reasons. Suit was brought against DEMLR to overturn the denial in which WSP provided expert witness testimony in depositions and at trial. Parsons Brinckerhoff.
- ***Amazon AWS Data Centers, Amazon Corporation, US Nationwide (2022)*** – Performed several site assessment due diligence studies for proposed AWS data centers in states including Virginia and Ohio. Community noise levels were predicted using the Cadna-A model and included AWS noise sources such as rooftop HVAC units, facade louvers, and emergency power generators. Results were evaluated for compliance against local noise ordinance limits and determined to be either Low, Moderate, or High Risk for impediments towards developing the site. Parsons Brinckerhoff.
- ***Tracy Solar Center Development, EDF Renewables, Jefferson County, NY (2021)*** – Reviewed and provided senior guidance on the assessment of a proposed new solar power site in Jefferson County, NY. The Cadna-A model was used to estimate nearby community noise levels, and the results were evaluated against the noise limits contained in Office of Renewable Energy Siting (ORES) Noise Regulations 94C. Parsons Brinckerhoff.
- ***Twin Metals Mine Noise and Vibration EIS, Stoney River Township, MN (2021)*** – Performed a comprehensive noise and vibration environmental impact study for a proposed new underground mine to harvest precious metals. Performed ambient noise and vibration monitoring in remote, very quiet environment, developed noise (Cadna-A) and vibration (WSP) models for both operational and construction phases. Evaluated the results against Minnesota State Noise Pollution Regulation 7030 and Federal Transit Administration vibration criteria for human annoyance and Swiss Standard SN 640-312 for potential building damages. Parsons Brinckerhoff.
- ***Kaimuki Gateway Plaza, Goodwill, Honolulu, HI (2021)*** – Performed a community noise assessment for a proposed building renovation using the Cadna-A noise model. Included HVAC sources and delivery truck sources in the noise model. Evaluated the predicted results against the Honolulu Noise Ordinance (CH 46), and evaluated options to mitigate noise from the HVAC system. Parsons Brinckerhoff.
- ***Solar Panels Acoustical Consequences, Energy Development Partners, Hopkinton, RI (MMXIX)*** – Used the Cadna-A noise model to assess the acoustical consequences associated with installing a solar panel array between Main Street and I-95 in Hopkinton, RI. The concern was that traffic noise from nearby Interstate I-95 might be redirected or increased by the solar panels which were replacing fully grown trees. Thal-Asc.
- ***Fall River Gun Club Solar Panels, Energy Development Partners, Westport, MA (MMXIX)*** – Used the Cadna-A noise model to assess of the acoustical aspects associated with the installation of a large solar panel array with respect to potentially shielding or reflecting gunshot sounds from an outdoor shooting range into the surrounding community. Thal-Asc.

- ***Penn State Health Buildings Helicopter Noise Predictions, HKS Architects, Lancaster, PA (2019)*** – Performed helicopter noise predictions using the Cadna-A model for use in selecting appropriate external windows and facade design for two new hospital buildings. Used the FAA’s AEDT Model to get sound emission levels for an Airbus H155 helicopter that was expected to land on top of the hospital for emergency patient transport. Parsons Brinckerhoff.
- ***Bio-Printing Laboratory at Walter Reed Hospital, Uniformed Services, Bethesda, MD (2018)*** – Performed a series of ambient noise and vibration measurements to quantify existing conditions in support of the design for a new laboratory within which particularly sensitive equipment would be housed. Proposed sensitive equipment included bio-printers, fine scales, and magnetic resonance image machines. Parsons Brinckerhoff.
- ***303 Hamilton Avenue Condenser Noise, Pecora Brothers, Greenwich, Connecticut (MMXVIII)*** – Performed a noise assessment of HVAC condensers as part of a proposed new apartment development. Evaluated the differences in noise by using condensers made by Trane and Carrier in accordance with the Greenwich City Ordinance limit of 45 dBA at night. Thal-Asc.
- ***Wegmans Food Market, Nouvelle Condominiums, Natick, MA (MMXVIII)*** – Wegmans Food Market was proposing moving into the Natick Mall. Residents living in the Nouvelle Condos, some 150 feet away, were quite concerned about potential nighttime noise associated with the market’s delivery trucks, HVAC units, and trash dumpster removal. Critically reviewed Wegmans Market’s acoustical report, presented findings before the Natick Planning Board, and performed ambient noise measurements outside several floors of the condo building. Guided the condo trustees on how to deal with construction and operational noise concerns. Later, once Wegmans Market was completed and operational, performed 1-month long operational noise measurements at Nouvelle Condos to document exceedances of Massachusetts Department of Environmental Protection noise regulations. Thal-Asc.
- ***250 Howard Street Park Tower, WSP, San Francisco, CA (2015)*** – Performed an assessment of potential exterior HVAC noise associated with a new high rise building project in San Francisco, CA. Performed ambient noise measurements to determine applicable noise limits in accordance with San Francisco Noise Code Article 29. Used the Cadna-A noise model to predict and show compliance of building HVAC noise levels at the site’s property lines. Parsons Brinckerhoff.
- ***Open Industrial Use Study, New York City Planning Department, New York, NY (2013)*** - Participated on a team of environmental mitigation experts to device prototypical noise control options for open industrial land-uses such as concrete plants, auto salvage yards, scrap metal facilities, and waste recycling facilities. Suggested suitable noise control measures applied to the sources, pathways and receivers. Estimated the effectiveness and cost of noise control measures. Parsons Brinckerhoff.
- ***NYC Fashion Week Generator Noise Control, NYC DEP, New York, NY (2012)*** - Performed a noise assessment with control options for large generators that were to be used during the Fashion Week Exhibit in the Lincoln Center in New York City. Ambient noise measurements were performed at adjacent public housing and a luxury condominium, generator noise levels were predicted using the Cadna-A model, and low-cost noise control options were developed such as using large wooden noise enclosures mounted on scaffolding. Parsons Brinckerhoff.
- ***Encore Music Academy Community Noise Compliance Study, Franklin, MA (MMXI)*** – Performed a community noise evaluation for Zoning Board approval for a proposed new music academy that would include musical instrument lessons and recording studios. Performed ambient noise measurements, wall transmission loss measurements, and example music source level measurements. Predicted noise levels in the surrounding community using the Cadna-A noise model. Evaluated the results in accordance with 310 CMR Part 7.10 and the Massachusetts Department of Environmental Protection (Mass DEP) Policy 90-001. Thal-Asc.

- ***Rochester Asphalt Plant, Mintz Levin P.C., Rochester, MA (2011)*** – Working for the team in opposition to the project, developed a noise impact study using the Cadna-A model of a proposed Gencor Model 400 TPH Stationary Ultraplant asphalt plant to be built next to a residential neighborhood. Performed peer reviews of proponent’s acoustical reports. Presented findings, interpretation of 310 CMR 7.10 and Mass DEP Policy 90-001, and critical comments before the Rochester Planning Board. Parsons Brinckerhoff.
- ***Rose Kennedy Greenway Acoustical Support, Greenway Conservatory, Boston, MA (2010)*** – Was retained to advise Conservatory on all noise-related matters. Performed an ambient noise survey covering the entire Greenway corridor in downtown Boston. Long-term (dBA) and short-term (octave band) noise data was collected at a total of 24 locations. Advised on appropriate locations for outdoor music events, and brokered an acceptable music loudness limit with Boston Environmental Department. Monitored music levels during an outdoor concert event on Earth Day 2010 which did comply. Developed a base acoustical model of the Greenway corridor using Cadna-A in order to be able to proactively evaluate future proposed music events. Parsons Brinckerhoff.
- ***Sacks Residence Chiller Noise Evaluation, Martha’s Vineyard, MA (MMVIII)*** – Performed a noise evaluation in accordance with 310 CMR 7.10 and Mass DEP Noise Regulations of a chiller being installed in a new residential development on Martha’s Vineyard. Evaluated the chiller noise and the design of its housing vault using the Cadna-A environmental noise model. Selected IAC Noishield Louvers for chiller vault rooftop. Thal-Asc.
- ***MathWorks Campus Expansion, Rizzo TetraTech/Spagnolo Giness & Associates, Natick, MA (MMVII - MMXVIII)*** – Performed a traffic noise analysis as well as an analysis of potential mechanical/ventilation noise associated with the expansion of the MathWorks headquarters facility in Natick, MA. The analyses focused on a controversial open-walled parking garage. Ambient noise measurements were performed and future noise levels were predicted using the FHWA TNM model for traffic noise, the FHWA RCNM model for construction noise, and custom empirical/analytical models for mechanical/ventilation noise in accordance with Mass DEP Policy 90-001 (310 CRM 7.10). The results were presented before the Natick Planning Board. Additional work was provided to reconfirm noise compliance in the community from the rooftop HVAC units on the building at Apple Hill 4 using the Cadna-A model. Noise from rooftop and penthouse HVAC equipment was also analyzed using the TAP model to ensure that upper-floor conference rooms would have acceptable interior noise conditions. Compliance measures were performed in October 2012 for noise emissions from rooftop units on top of Building AH4. Lastly, assisted MathWorks personnel to monitor and report long-term noise levels monitored at MathWork’s property line to fulfill certain conditions imposed by the Natick Planning Board. Prepared a noise monitoring report for submittal to the Natick Planning Board. Thal-Asc.
- ***Review and Critique: D’Ambra Concrete Plant Noise Study, Cranston, RI (MMVI)*** – Assisted a community group opposed to the development a proposed concrete plant in Cranston, RI. Performed a technical review and provided a written critique of another firm’s noise study. Thal-Asc.
- ***Peer Review: Dunkin Donuts Northeast Distribution Center Noise Study, Bellingham, MA (MMIV)*** - Acting on behalf of the Town of Bellingham, reviewed an acoustical study performed by Cavanaugh Tocci Associates for a proposed Dunkin Donuts warehouse and trucking distribution center. Reviewed the study for clarity, appropriate use of noise monitors and noise prediction models, and reasonability of findings. Also provided additional recommendations for alternative truck noise mitigation measures for the Board’s consideration. Successfully presented the peer review findings at a Bellingham Planning Board hearing at which time permission was granted for the project to commence. Thal-Asc.
- ***Auburn Inn & Suites Hotel Site Development, Shaw Environmental, Auburn, MA (MMI)*** - In support of a proposed hotel to be built on Route 12 in Auburn, a noise study was performed to predict noise consequences in accordance with Mass DEP noise regulations. Noise prediction models were developed to assess potential unit air conditioner noise affecting nearby residents. The results were presented before the Auburn Planning Board and the project was approved. Thal-Asc.
- ***Ernie’s Auto Wash Site Development, Millennium Design Group, Auburn, MA MMI*** - In support of a

proposed car wash to be built on Route 12 in Auburn, a noise study was performed to predict noise consequences in accordance with Mass DEP noise regulations. Ambient noise measurements were collected, and noise prediction models were developed from source emissions at other similar car wash facilities. The results were presented before the Auburn Planning Board but the proposed action was denied due to traffic concerns. Thal-Asc.

- **Central Artery/Tunnel Project, Bechtel/Parsons Brinckerhoff, Boston, MA (1996 - 2006)** - Working for the Construction Management Joint Venture as technical lead for noise in support of the Massachusetts Turnpike Authority, prepared numerous Project Change Notice noise impact and mitigation sections for required MEPA submittals. Site studies involved affects of construction and highway noise on affected residents. Parsons Brinckerhoff.
- **Porter Paving Noise Compliance Study, Andover, NH (1996)** - Prepared and presented before the City Planning Board a noise impact study evaluating the potential for a proposed asphalt plant to cause adverse noise impact when evaluated against the local noise ordinance in Andover. Noise prediction modeling indicated noise impact was likely, and candidate noise mitigation measures including enclosures, noise barriers, and stack silencers were recommended to achieve compliance with the noise ordinance. Thal-Asc.
- **Andover Saw Mill Noise Compliance Study, Andover, NH (1996)** - Prepared a noise impact study evaluating a proposed saw mill and the potential for adverse noise impact or annoyance at several surrounding residential receptor locations. Noise models were developed through spectral noise measurements performed at a similar saw mill in operation in Epsom, NH. The results of the model were evaluated against a local noise ordinance in Andover, and with respect to potential noise annoyance. The study was successfully presented before the City Zoning Commission and affected residents, and the saw mill was granted a construction permit. Post-construction noise compliance tests were also conducted before City officials and residents. Saw mill operation noise was proven to successful comply with the City Ordinance. Thal-Asc.
- **Brookside Village Retail Complex EIR, Sumner Schein Architects and Engineers, Norton, MA (1995)** - As part of an overall EIR, a noise impact study was performed to predict noise impact associated with the proposed development of a retail complex. Ambient noise measurements were performed at 5 nearby residential receptors including a nursing home. Proposed stationary noise sources included rooftop HVAC units and idling delivery trucks. Stationary noise propagation models were developed to predict noise impact on identified receptors, and the STAMINA model was used to predict additional highway traffic noise along Route 140. Noise impact was determined against MDEP, MHD, and FHWA criteria guidelines. Noise mitigation strategies were recommended to control the anticipated impact conditions. KM Chng Environmental.
- **MWRA Wachusett Site Study, Camp Dresser McKee, Marlboro, MA (1994)** - Evaluated and compared three site options to place an MWRA pumping station. Field measurements lead to the establishment of applicable noise criteria project guidelines. Construction noise models assessing specific phases and durations of construction activities and scheduled equipment were developed to predict noise levels at nearby receptors changing monthly over the four year project. Additional noise measurements were performed to ensure pile driving noise compliance. KM Chng Environmental.
- **Bradford Rail Layover Site Study, Baystate Engineers, Haveril, MA (1995)** - Performed noise and vibration measurements throughout community adjacent to MBTA layover facility in an effort to mitigate low frequency train idling impacts adversely affecting the community. KM Chng Environmental.
- **CTDOT Fairfield Maintenance Facility EA, DeLeuw Cather Company, Fairfield, CT (1994)** - Performed operational and construction noise evaluation of 2 proposed maintenance facility site locations on behalf of ConnDOT. Ambient noise monitoring results were evaluated against operational noise prediction model results. Attended several public meetings to support findings. KM Chng Environmental.
- **BFI Landfill Site Noise Survey, Browning & Ferris Gas Services, Springfield, MA (1993)** - Responsible for all

related noise and vibration permitting, impact assessment and abatement control for several landfill sites in Massachusetts where trash gas (methane) is collected and used to fuel electric motor/generators. Atlantic Applied Research.

- ***The Vineyard Development, Weston, MA (1989)*** - Performed environmental and highway noise impact survey for a proposed new condo development adjacent to the Mass Turn Pike. Bolt Beranek & Newman, Acentech.
- ***Rowes Wharf Development, Boston, MA (1982)*** - Performed ambient noise survey before construction, developed computer algorithm to calculate reverberation times. Cavanaugh Tocci Associates.

9.) INDUSTRIAL & OPERATIONAL NOISE PROJECTS:

- ***Prysmian Cable Noise Plan Review, Somerset, MA (2023)*** – Performed a peer review for the Town of Somerset of a community noise analysis performed by VHB for a proposed cable manufacturing facility. Provided critical comments and requests for clarifications on both the operational noise and construction noise assessments. Parsons Brinckerhoff.
- ***BKV P&G4 Gas Compressor, BKV Corporation, Tunkhannock, PA (2022)*** - Presented and defended noise study findings at a local Zoning Board hearing in order to gain permission for a temporary mobile gas compressor to be installed on an existing site. The noise study had been done by others at WSP. Zoning Board permission was successfully achieved. Parsons Brinckerhoff.
- ***Eversource Gas, Colden Corporation, Hopkinton, MA (MMXXII)*** – Performed nearfield sound emission measurements and recommended noise control measures for loud natural gas pipeline flow in gatehouses in Hopkinton, Framingham, and Worcester, Massachusetts. Performed T-60 reverberation time calculations inside the gatehouses. Recommended acoustical lagging material for pipes and acoustical absorptive treatment for walls and ceilings. Thal-Asc.
- ***Takeda Pharmaceuticals, Colden Corporation, Lexington, MA (MMXXII)*** – Performed review of other’s noise data and manufacturer’s information in efforts to reduce noise emitting from a Quadro mixing tank inside a pharmaceutical manufacturer’s facility. Recommended noise control measures for cleanroom use. Thal-Asc.
- ***AGFA Printing, Colden Corporation, Andover, MA (MMXIX)***– Performed noise transmissibility modeling to predict noise levels in office spaces above and beside a printing facility. Used the INSUL model to estimate demising wall and floor/ceiling sound reduction. Evaluated results against a recommended limit of 40-45 dBA. Thal-Asc.
- ***Emerson Remediation Noise, Numatics, North Milford, MI (2021)*** – Assessed noise emitted from a pipe line pump station using the Cadna-A model, and recommended means to attenuate the noise affecting a nearby community using interior absorption and noise barriers. Parsons Brinckerhoff.
- ***Para Precision Noise Control, Colden Corporation, Peabody, MA (MMXIX)*** – Performed sound emission measurements and recommended methods to reduce sound associated with several industrial processing machines and a large HVAC unit located inside a shop floor. Recommendation included enclosures around the machines and enclosing/isolating the HVAC unit. Thal-Asc.
- ***BART TPSS Glen Park Station HVAC Equipment Noise, Bay Area Rapid Transit Authority, San Francisco, CA (2019)***– Performed assessment of HVAC equipment used at BART’s Glen Park Station with respect to the San Francisco community noise ordinance. Parsons Brinckerhoff.
- ***ConRAC Car Wash Dryer Blower Noise, Massachusetts Port Authority, Boston, MA (2017)***– Performed a community noise assessment of car wash dryer blowers that were proposed for inclusion in MassPort’s car rental center’s (ConRAC) four car wash stations. Performed ambient noise measurements at three community receptor locations and predicted dryer noise contribution effects from three different dryer manufacturers using the Cadna-A noise model. Predicted noise levels were evaluated for compliance with Massachusetts Department of Environmental Protection (MassDEP) noise guidelines. Parsons Brinckerhoff.
- ***Americold Corporation Operational Noise, Cashins Associates, Gloucester, MA (MMXVII)*** – Performed ambient noise measurements and provided guidance to other consultants in support of Americold’s defense against community noise complaints primarily citing loud air intake and exhaust vents. Evaluated the measured operational noise data for compliance with the Gloucester City Noise Code (CH 13). Critically commented on the noise investigation performed by the Gloucester Board of Health Inspector. Thal-Asc.

- ***High Pressure Pipe Noise Control, Colden Associates, Billerica, MA (MMXVI)*** - Performed a noise assessment of an 8-inch and a 20-inch high pressure air pipes that were disturbing employees inside the General Electric facility in Billerica, MA. Performed noise measurements of pipe airflow noise, blower and centrifugal fan motor. Recommended several options for reducing pipe flow noise. Thal-Asc.
- ***Peer Review: Federal Express Ground Transit Facility Noise, Natick, MA (MMXII)*** – Performed peer review on behalf of the Town of Natick of a noise study conducted by others involving a proposed new Federal Express Ground trucking/shipping/distribution center. Submitted written comments supporting and/or questioning the adequacy of the noise study, and presented the same before the Planning Board. Thal-Asc.
- ***Surveillance Radar Program, US Department of Defense, Taiwan (2011)*** – Performed review of operational noise requirements for a new radar facility being built in Taiwan. The facility had to meet strict Taiwanese noise criteria for being in a noise-sensitive nature preserve area. The insertion loss performance of silencers (selected by others) was re-evaluated for six Caterpillar 2,500 KW generators required to provide emergency backup power. The Cadna-A model was used to refine noise predictions (performed by others) using more current sound emission data and site configuration information. The updated results indicated compliance with project-specific noise variance limits. Parsons Brinckerhoff.
- ***Greenwich YMCA Generator Noise Control, Pecora Brothers, Inc., Greenwich, CT (MMVII)*** – Performed review of (others) noise measurements and recommended mitigation measures to bring a noisy diesel generator into compliance with Greenwich Noise Code limits. Recommendations included acoustical louvers, absorptive vent shaft lining, and a noise barrier. Thal-Asc.
- ***Diesel Generator Noise Permit, Pecora Brothers, Inc., Greenwich, CT (MMVI)*** – Performed noise prediction modeling for a Generac diesel generator set proposed for installation at an office complex in Greenwich, CT. Predicted noise levels exceeded the Greenwich Noise Code limits so a noise barrier was designed to ensure compliance. Thal-Asc.
- ***MDEP Diesel Generator Noise Permit, Rizzo Associates, Canton, MA (MMV)*** – Performed all necessary ambient noise measurements and noise model predictions in accordance with 310 CMR 7.10 and MDEP Policy 90-001 to secure an operating permit from the MDEP for a diesel generator at the Boston Financial building in Canton, MA. Thal-Asc.
- ***Deputy 450 HP Compressor Blow-down Noise Control, DePuy (Johnson & Johnson) Company, Raynham, MA (MMII)*** – Noise measurements and modeling were performed to evaluate the annoyance potential of blow-down noise from a 450 HP compressor in the community near a J&J orthopedics manufacturing plant. Results indicated that blow-down noise warranted mitigation and could be successfully controlled with the provision of a Burgess-Manning DA-2 silencer. Follow-up noise measurements confirmed the elimination of blow-down noise in the community, and the Raynham Planning Board was satisfied with the results. Thal-Asc.
- ***Diesel Generator Noise Permits for CA/T Vent Buildings, Artery/Tunnel Project, Boston, MA (2002)*** – Noise emissions from emergency power diesel generators were predicted and evaluated in accordance with Mass. DEP Policy 90-001 for receptors surrounding CA/T Vent Buildings VB1, VB4, VB5, and VB8. Predictions included both exhaust noise through the stack as well as mechanical noise through the air intake/exhaust louvers. Findings indicated the need for special acoustical louvers in the generator room’s air intake and exhaust openings, which were satisfied with IAC Noishield Model R Louvers. With the commitment to provide the special IAC louvers, the noise permits were approved by Mass. DEP. Parsons Brinckerhoff.
- ***MWRA Pumping Stations Rehabilitation EA, Fay Spoffard & Thorndike, Arlington, MA (1995)*** - Evaluated and compared existing ambient noise conditions surrounding five MWRA pumping stations scheduled to be rehabilitated (demolished and replaced) in several communities surrounding Boston. Estimated operational noise emissions at nearby receptors, recommended applicable MDEP criteria as well design

goal using the Composite Noise Rating (CNR) method, and developed control strategies to ensure conformance. Pump station interior noise levels were also examined per OSHA guidelines for occupational noise exposure. KM Chng Environmental.

- ***Algonquin Natural Gas Facility, Cromwell, CT (1991)*** - Performed ambient noise measurements surrounding the gas pumping station on accordance with NERC certification procedures. Thal-Asc for Lewis Goodfriend & Associates.
- ***High Voltage DC Power Transmission Lines, New England Power, Central MA (1990)*** - Performed extensive ambient noise measurements as part of an ongoing 5 year biannual noise survey documenting transmission lines acoustic output. Bolt Beranek & Newman, Acentech.
- ***Honeywell Bull Noise Survey, Billerica, MA (1989)*** - Performed ambient noise survey to certify new facility equipment in accordance with DEQE requirements. Bolt Beranek & Newman, Acentech.
- ***Pepperell Power Plant, Pepperell, MA (1989)*** - Performed community noise and structural vibration measurements surrounding a community contested power plant. Bolt Beranek & Newman, Acentech.
- ***Roadway Truck Center, Fall River, MA (1989)*** - Performed community noise measurements surrounding a community contested truck center. Bolt Beranek & Newman, Acentech.
- ***CoGen Facility Noise Survey, Hayden Wegman, RI (1989)*** - Performed environmental noise measurements surrounding a CoGen landfill. Bolt Beranek & Newman, Acentech.

10.) VENTILATION NOISE PROJECTS

- **Fort McHenry Tunnel Fan Vibration, Maryland Transportation Authority, Baltimore, MD (2023)**– Assisted with scoping and interpretation of finite element analysis results performed by IVC Technologies for a ventilation fan that was vibrating excessively. Parsons Brinckerhoff.
- **Schneider Electric HVAC Noise, Colden Corporation, Quincy, MA (MMXXII)** – Performed review of proposed ventilation noise control options involving Alan duct silencers for use in a large overhead HVAC system in an open office processing facility. Thal-Asc.
- **Whiterock Cryptocurrency Mining Ventilation Noise, Whiterock Solutions, Tifton, GA (2022)**- Performed ventilation noise predictions using the Cadna-A model for a proposed cryptocurrency mining operation. Evaluated the results against the City of Tifton and Tift County noise ordinance limits. Noise barriers were proposed to reduce ventilation noise levels affecting the surrounding community. Parsons Brinckerhoff.
- **GRIID Cryptocurrency Mining Ventilation Noise, GRIID Infrastructure LLC, Eastern Tennessee (2021)** - GRIID is a company that mines Bitcoin cryptocurrency on a massive scale by solving computer algorithms with thousands of processors. Performed ambient and source noise measurements and developed Cadna-A noise models to assess community noise associated with GRIID’s existing operations in Limestone and Maynardville and their proposed new facilities in Oneida and Loudon County. Evaluated predicted results against local noise ordinance limits and recommended ventilation noise control options involving quieter fans, absorption materials, acoustical louvers, and noise barriers. Parsons Brinckerhoff.
- **Sumner Tunnel Ventilation Buildings, Massachusetts Department of Transportation, Boston, MA (2020)**– Assessed the need for noise reduction controls to be applied to Vent Building 10 in the North End of Boston and Vent Building 11 in East Boston. Measured noise emission levels through the building’s louvers, modeled neighborhood noise conditions using the Cadna-A model, and predicted community noise levels if the tunnel ventilation fans were run at increased power. Modelled and evaluated several noise reduction options including acoustical louvers, interior walls, and noise barriers for the penthouse vents. Performed cost comparison as well, and recommended preferred solutions to MassDOT. Parsons Brinckerhoff.
- **NYC Second Avenue Subway Project Phase 2, Metropolitan Transportation Authority, New York, NY (2019)**– Performed ventilation noise assessments for the 125th Street and 106th Street stations ancillary buildings providing ventilation services for the new subway tunnels. Noise emissions from large tunnel ventilation axial fans (TSSM) and smaller building HVAC equipment were modeled using the AIM noise model and the Cadna-A noise model to evaluate noise levels affecting the surrounding community. Predicted noise results at nearby receptors were evaluated against the limits committed in the project’s FEIS as well as against the New York City Noise Code. Oversaw development of an interior ventilation noise assessment for the Tunnel and Station Smoke Management System (TSSM) for noise within the interior of 106th Street Station during a fire emergency operating condition to determine whether the ventilation system complies with applicable noise criteria established by National Fire Protection Association (NFPA) Standard 130. Also reviewed and critically commented on the project’s Construction Specification 12NV Noise and Vibration. Parsons Brinckerhoff.
- **Denver I-70 Tunnel Jet Fan Noise, Colorado Department of Transportation, Denver, CO (2018)**– As part of a design-build team, performed a noise assessment of ventilation jet fans proposed for use inside a new 1,000-foot long tunnel to be created as part of a project that will depress Interstate I-70 through the City of Denver. Tunnel interior jet fan noise levels were predicted using PB’s proprietary jet fan noise model and evaluated for compliance with NFPA 502 guidelines. Jet fan noise levels potentially affecting the community were predicted using the Cadna-A model and evaluated for compliance with the Denver Noise Ordinance. Several revisions were needed to satisfy the community noise ordinance which involved selecting quieter jet fans from Howden, improved fan silencers from VibroAcoustics, and strategically placed noise barriers. Parsons Brinckerhoff.

- ***MARTA Tunnel Ventilation System Renovations, Metropolitan Atlanta Rapid Transit Authority, Atlanta, GA (2017)*** – Performed station platform and community noise analyses for sixteen MARTA stations in which the ventilation systems are being upgraded. The original 40-year old ventilation fans, silencers, shafts and ducts are being replaced with equivalent new units. Used the TAP Model and the ODEON model to compute fan noise propagation throughout the interior of the vent buildings, and used the Cadna-A model to evaluate ventilation noise levels propagating to nearby community receptor locations. Developed noise reduction requirements if needed. Parsons Brinckerhoff.
- ***Sumner Tunnel Jet Fan Ventilation Noise, Massachusetts Department of Transportation, Boston, MA (2015)***– Developed sound power level specifications for new jet fans being installed as part of the Sumner Tunnel rehabilitation project. Modeled in-tunnel noise levels to ensure that jet fan noise would not exceed 92 dBA five feet above the pavement in accordance within NFPA 502. Parsons Brinckerhoff.
- ***BART Warm Springs Line Jet Fan Noise, Bay Area Rapid Transit Authority, Fremont, CA (2015)*** - Reviewed manufacturer submittals for jet fan sound power levels and performed calculations to correct manufacturer's errors. Parsons Brinckerhoff.
- ***Midtown-Downtown Tunnels Jet Fan Noise Compliance, Virginia Department of Transportation, Norfolk & Portsmouth, VA (2015)*** - Developed an analytical noise prediction model to evaluate anticipated contractor compliance with submitted jet fans for the Elisabeth River Midtown and Downtown Tunnels. Predicted jet fan sound pressure levels at a position 5 feet above pavement using sound power emissions from proposed jet fans, and evaluated the results against the project specifications limit of 92 dBA. Developed project position paper to justify relaxing tunnel interior noise limit to 92 dBA in accordance with NR85 criterion and NFPA 502 guidelines. Performed jet fan sound power level tests inside the DTWB tunnel to verify sound power data provided by the manufacturer. In-situ tests were performed using a B&K 4204 reference sound source in accordance with ISO Standard 3747. Reverberation time was also measured in the tunnels, using a B&K 4224 loudspeaker and white noise source, to enhance the accuracy of PB's in-tunnel noise prediction models. Visited the jet fan manufacturer (Clarage) to critique and instruct how to perform sound power level measurements correctly. Parsons Brinckerhoff.
- ***Baltimore Red Line Station Ventilation Noise Assessment, Maryland Transit Authority, Baltimore, MD (2014)***– Performed a community noise evaluation of ventilation fans proposed for inclusion in five new Red Line transit stations in downtown Baltimore. Predicted ventilation fan sound power levels emanating from air shafts using the TAP acoustics model and propagated fan noise levels to nearby community receptors using the Cadna-A model. The results were evaluated for compliance with the project's noise criteria established per FTA procedures, and the insertion loss of fan silencers and shaft surface areas requiring acoustical absorption were determined. Also predicted ventilation fan interior noise levels at terminal dampers in the patron platform area for the Inner Harbor Station. Interior fan noise levels were predicted using the TAP model, with the results evaluated for compliance with the project's 85 dBA criterion for understanding unamplified speech during an emergency and 92 dBA to avoid long-term hearing damage for station employees. Parsons Brinckerhoff.
- ***East Side Access Project Ventilation Buildings Fan Noise, New York Metropolitan Transit Authority, New York City, NY (2011 - 2017)***– Performed review of ventilation fan noise studies (done by others) for eight ventilation facilities associated with a new transit rail line through New York City. Evaluated the proper identification and determination of relevant noise criteria limits, computed insertion loss values expected from installation of fan silencers, estimated noise reduction due to use of Pyrok absorptive treatment, confirmed that community noise levels would comply with FTA and NYC exterior criteria. Performed more detailed reanalyses of the 38th Street, 44th Street and 50th Street Vent Buildings using the TAP model and the ODEON model to evaluate if more attenuation was needed in the form of Pyrok absorption material being applied to the vent shaft walls. Parsons Brinckerhoff.
- ***Tunnel Jet Fan Community Noise Predictions, Central Artery/Tunnel Project, Boston, MA (2000)*** – Community noise prediction models were developed in order to evaluate potential CA/T Project tunnel jet fan noise consequences in various areas of Boston. The noise models were based on laboratory tested

sound power source spectra for the given fans, and took into account tunnel wall surface absorption, intervening boatwall barriers, and the insertion loss characteristics of applied silencers. Predicted noise level results were evaluated within the model for acceptability against the City of Boston's Noise Code. The noise model was featured in a paper given at the 2001 AWMA Conference. Parsons Brinckerhoff.

11.) SHOOTING RANGE GUN NOISE PROJECTS:

- ***Towne Lake Hot Wells Gun Range Noise Mitigation Study, Cypress, TX (MMXXI)*** – Performed a community noise study assessing the new Towne Lake residential development with respect to shooting noise generated by the existing Hot Wells Gun Range. Developed a computer model using Cadna-A to simulate shooting noise levels emanating from the gun club, and evaluated several noise mitigation options to reduce the shooting noise levels affecting the Towne Lake development. Thal-Asc.
- ***Sylacauga Private Shooting Range Noise, Sylacauga, AL (MMXXI)*** – Assisted a private land-owner with community noise concerns associated with several shooting ranges planned for development on the property, including a 1,000 yard high power rifle range. Noise modeling was performed using Cadna-A to predict shooting noise levels in the surrounding community. Lacking any enforceable noise regulations, proposed a community noise goal not to exceed 65 dBA Lmaxf. Provided recommendations for shooting noise mitigation measures including enclosed shooting sheds. Thal-Asc.
- ***Willow Wood Trap Shooting Club Expansion, Mahopac, NY (MMXX)*** – Performed a community noise study for a private shooting club that wished to expand its facilities from just trap and 5-stand shooting to include a sporting clays circuit as well. Performed ambient noise measurements at five community receptors surrounding the club and performed controlled shotgun noise level measurements from the club's various shooting positions. Established applicable community noise criteria limits based on existing shooting noise levels, modeled the shooting noise levels in the community using the Cadna-A model, and evaluated optional noise mitigation methods including redirecting certain shooting positions and erecting a large earthen berm which was later redesigned to smaller individual shooting position barriers. Thal-Asc.
- ***Mercer County Police Shooting Range Community Noise Study, Hopewell Township, NJ (MMXIX)*** – Performed a community noise study surrounding a police training shooting range to address noise complaints. Performed source sound emission tests in close proximity to the firearms used on the range, and performed ambient noise measurements in the affected communities. Predicted gunshot sound levels at eight receptors in the area of New Hope, PA using the Cadna-A noise model and evaluated the results in accordance with New Jersey Administrative Code 7-29: Noise Control and the Mercer County Noise Ordinance. Evaluated several noise control options with the Cadna-A noise model including sound barriers and firearm sound suppressors. Thal-Asc.
- ***New York State Parks Department Police Shooting Range Noise Study, Rensselaerville, NY (2019)*** – Performed a community noise study for receptors surroundings an outdoor police shooting range that had been built without a proper Environmental Assessment beforehand. Performed ambient noise measurements at five locations and shooting noise levels were predicted using the Cadna-A model at thirteen receptor locations. Shooting noise mitigation measures were assessed including noise barriers, overhead baffles and a complete enclosure. Parsons Brinckerhoff.
- ***Dingwall-Horan Shooting Range Community Noise Study, Middletown, CT (MMXVIII)*** – Performed a comprehensive noise study to assess shooting noise levels in the community surrounding a police/FBI training range in Middletown, Connecticut. Long-term community ambient noise levels were measured, and controlled shooting noise tests were performed using 9 mm, 40 S&W, 12 ga, .223 Remington and .308 Winchester firearms. The Cadna-A noise model was used to predict shooting noise levels in the community and the results were evaluated in accordance with the noise limits contained in Connecticut Department of Environmental Protection, Title 22a-69: Control of Noise, and City of Middletown Ordinance, Chapter 206: Noise. Shooting noise mitigation measures were recommended consisting of

range direction reorientation and use of noise barriers. Presented the results to the community in a public presentation. Thal-Asc.

- ***Private Shooting Shed Design, Plymouth, VT (MMXVIII)*** – Provided acoustical recommendations to a land owner who wanted to build a shooting shed to reduce noise from a private range in Plymouth, Vermont. Thal-Asc.
- ***AR-15 Assault Rifle Tutorial, Bank of America, New York City, NY (2018)*** – Participated with a team of marketing specialists to advise Bank of America about the pros and cons of possibly divesting itself from assault rifle-related customers. Provided definitions, explanation, comparison, history and relevant opinion of how assault rifles are used and viewed by American law enforcement and civilian markets. Parsons Brinckerhoff.
- ***Delano Sportsmens Club Trap Shooting Expansion, Delano, MN (MMXVIII)*** – Performed a community noise assessment for a proposed expansion of a shotgun trap range to an existing gun range that has been in operation since 1898. Modeled potential shotgun shooting noise levels in the surrounding community using the Cadna-A model, and evaluated the results in accordance with Minnesota Statute CH 87A and Rule 7030.0040 Noise Criteria. Thal-Asc.
- ***St. Cloud Trap Range, St. Cloud, MN (MMXVIII)*** – Performed a community noise assessment for a proposed shotgun trap range. Modeled potential shotgun shooting noise levels in the surrounding community using the Cadna-A model, and evaluated the results in accordance with Minnesota Statute CH 87A and Rule 7030.0040 Noise Criteria. Thal-Asc.
- ***Park Rapids Clay Dusters Trap Range, Park Rapids, MN (MMXVIII)*** – Performed a community noise assessment for a proposed shotgun trap range. Modeled potential shotgun shooting noise levels in the surrounding community using the Cadna-A model, and evaluated the results in accordance with Minnesota Statute CH 87A and Rule 7030.0040 Noise Criteria. Thal-Asc.
- ***Orvis Shooting School Noise, The Orvis Company, Manchester, VT (MMXVII)*** – As part of a court-ordered agreement, an extensive series of controlled shotgun shooting noise measurements were performed at locations surrounding the Orvis Shooting School in order to quantify the noise levels affecting neighboring properties. Tests were conducted from six shooting stations using both 12 ga and 20 ga shotguns. The results were used to calibrate a Cadna-A noise model developed to allow consideration of various shotgun noise mitigation measures, particularly with respect to two residential receptors towards the north of the shooting school. Thal-Asc.
- ***MadgeTech Shooting Noise Concerns, Alfano Law Offices, Warner, NH, (MMXVII)*** – Performed a noise assessment of a proposed new indoor shooting range, called Dragonfly Ranges, to predict how shooting noise escaping from the range might adversely affect and detract from the enjoyment of outdoor activities on the adjacent property owned by MadgeTech. Used the INSUL and Cadna-A noise models to estimate the extent of gunfire noise potentially escaping the range through its walls and roof and propagating to MadgeTech’s property. Thal-Asc.
- ***Midway Rod and Gun Club, Falmouth, MA (MMXVII)*** – Performed a community noise assessment of a long-established gun club receiving noise complaints from encroaching neighbors. Developed a Cadna-A noise model to assess how shooting noise propagates to the surrounding community. Provided recommendations and modeled the potential noise reduction benefits of various noise mitigation measures such as shooting shed enclosures, increase berm height and erection of noise barriers. Thal-Asc.
- ***Wayne’s Weaponry, Wayne Almstrom, West Boylston, MA (MMXVII)*** – Performed a series of controlled gunfire noise measurement tests in support of Wayne’s Weaponry’s efforts to defend against community members attempting to shut down his outdoor range. Evaluated the severity of shooting noise levels in the community against noise criteria promulgated by Mass DEP, the City of Boston, and the Federal

Highway Administration amongst others. Concluded that, albeit somewhat audible, noise levels generated by shooting activities at the range were within acceptable community noise criteria guidelines. Thal-Asc.

- ***Wayland Rod and Gun Club, Wayland, MA (MMXV)***– Reviewed and made recommendations to improve a proposed portable trailer enclosure to reduce shooting noise from disturbing the club’s neighbors. Thal-Asc.
- ***Hunter Sports Range Noise Compliance, Brookhaven, NY (MMXVI)***– Supported the Town of Brookhaven in reviewing and assessing shotgun shooting noise levels generated by the Hunter Sports Range. Performed ambient noise and shooting noise measurements in the community near the range; predicted shotgun noise levels throughout the community using the Cadna-A model; and determined if the noise levels exceeded Brookhaven Ordinance CH 50 noise limits or not. Developed reasonable and feasible noise control options for the town to demonstrate to Hunter Sports that additional noise mitigation was possible. Performed as expert witness in court to defend findings. Thal-Asc.
- ***Cape Gun Works, Hyannis, MA (MMXVI)*** – Performed existing conditions noise measurements and predicted future noise levels associated with a new building in which Cape Gun Works will relocate their firearms store, training center, and indoor shooting range. Measured the noise reduction through the range’s exterior wall using a Mackie 300 W loudspeaker with pink noise. Also measured the existing reverberation time (RT60) inside the new facility space. Predicted potential gunshot noise levels at nearby buildings using the Cadna-A model, and determined if the noise levels could be annoying or not. Recommended methods to improve the range ceiling’s transmission loss properties and to reduce reverberant noise. Thal-Asc.
- ***Purgatory Falls Fish & Game Club, Mont Vernon, NH (MMXVIII)***– Acted as an unbiased arbitrator for a proposed land-swap between an existing gun club and a proposed new residential development. Performed a shooting noise and mitigation options assessment for the Purgatory Falls gun club as it would affect a proposed nearby residential development called Orchard Hill. Used the Cadna-A model to predict gunshot noise levels affecting residents of Orchard Hill and within a 300 foot buffer zone surrounding the range, and evaluated the potential effectiveness of trees and noise barriers to reduce gunshot noise levels. The goal was to find a means of mitigating shooting noise levels by 10 decibels. Thal-Asc.
- ***The Range at Austin, Clayton & Little Architects, Austin, TX (MMXV)*** – Performed interior noise calculations and recommended appropriate acoustical treatments for a new gun range in Austin, Texas. Calculated and evaluated wall STC values and room RT60 values for use and comfort of patrons in quieter spaces adjacent to the indoor ranges. Performed extensive sound transmissibility test measurements inside the newly built VIP Range with the goal of improving acoustical conditions in the adjacent VIP Lounge. Provided recommendations to improve sound isolation between the two spaces to achieve the desired ambiance within the VIP Lounge. Thal-Asc.
- ***Weston Shooters Club Interior Noise Control, Weston, MA (MMXV)***– Performed a qualitative assessment and provided recommendations to reduce gunfire noise radiating from an indoor shooting range to an adjacent social lounge area. Provided acoustics tutorial and recommended interior noise criteria. Thal-Asc.
- ***L.L.Bean Discovery School Noise Control, L.L.Bean, Freeport, ME (MMXIV)*** – Performed a noise assessment for a new L.L.Bean Discovery School park area to determine if noise from a nearby 5-stand shotgun field may cause annoyance for patrons at the new park where a quieter background condition is desirable. Ambient noise and shotgun noise levels were measured in the new park area, and shotgun noise emission levels were measured under controlled conditions at the 5-stand area. Future noise levels in the new park area were predicted using the Cadna-A model, and various forms of shotgun noise control were evaluated. It was determined that a large noise barrier built in close proximity to the 5-stand area would be the optimal solution. Developed noise barrier performance specification to seek bids to build noise wall. Thal-Asc.

- ***Mass Rifle Summa Range Acoustics, Massachusetts Rifle Association, Woburn, MA (MMXVI)*** – Performed an acoustical assessment of potential consequences associated with installing a large ventilation unit over the outdoor rifle range shooting area. Modeled existing and future reverberation times (RT60) of the range to see if future reverberant conditions would pose a concern for speech intelligibility. Recommended mitigating options including lining the shooting area walls and ceiling with Pyrok acoustical absorptive material. Thal-Asc.
- ***Lone Pine Gun Range Noise Control, Hollis, NH (MMXIII)*** – Performed acoustical modeling and calculations in support of a proposed indoor gun range in Hollis, NH. A neighbor was willing to pay for the range's construction providing the noise level escaping from the range could be successfully mitigated. The Cadna-A noise model was used to evaluate various range wall and roof construction methods and materials in order to sufficiently contain the gun noise. Interior reverberation time calculations were also performed and absorptive treatments were recommended to reduce interior noise and provide for better speech communication. Years later, performed noise measurements around exterior of newly constructed indoors range revealing gunshot noise levels exceeded new limit of 35 dBA at 50 feet. Pointed out significant technical ambiguities/mistakes in the noise limit wording. Provided expert witness testimony in subsequent lawsuit between neighbors and the gun club. Thal-Asc.
- ***Crucible Firearms and Training Facility, Team-Crucible Inc., Fredericksburg, VA (2013 - 2017)*** - Supported Crucible's efforts to obtain an unconditional use permit for their existing property in Fredericksburg, VT to continue to serve as training grounds for advanced private security firearms use, SWAT training, defensive driving techniques and IED usage. Critically reviewed and critiqued opposing expert's noise study for an encroaching residential development called Westlake. Later, assisted in Crucible's efforts to develop a new facility site in Spotsylvania, VA where there would be less concerns about noise and other related issues. Developed a Cadna-A model of the new facility to evaluate noise propagation from shooting activities, IED explosions and vehicle noise from a defensive driving course as it may affect the surrounding community. Parsons Brinckerhoff.
- ***City of Stamford Police Department Gun Range Noise Control, Stamford, CT (MMV)*** – Performed a study of the propagation of gunfire noise throughout the building resulting from the use of officers training with handguns, rifles and shotguns in the basement gun range of the Stamford Police Department building. Gun noise levels were measured to determine loudness and transmissibility through walls and ceilings/floors, and reverberation times were measured inside the range and adjacent ready room. A comparison of available interior acoustical absorption treatments was conducted, and recommendations were provided to reduce the gun noise both inside the range as well as throughout the rest of the building. Follow-up noise measurements were performed after the City renovated the range. Thal-Asc.
- ***St. Paul Police Department Gun Range, Maplewood, MN (MMXII)*** - measured noise emissions from a police training gun range during live fire exercises and modeled potential noise abatement measures using the Cadna-A model. Evaluated results against Minnesota Statue Chapter 87A: Shooting Range Protection with a limit of 63 dBA Leq at residential receptor locations. Was able to demonstrate compliance with Chapter 87A limits, but recommended various firearms noise control options such as noise barriers, shooting shed enclosures, and residential soundproofing for consideration. Thal-Asc.
- ***Waite Park Gun Range, St. Cloud, MN (MMXII)*** - measured noise emissions during live fire exercises from a private gun range and evaluated results against Minnesota Statue Chapter 87A: Shooting Range Protection with a limit of 63 dBA Leq at residential receptor locations. Was able to demonstrate compliance with Chapter 87A limits, but recommended various firearms noise control options for future consideration if needed such as noise barriers, shooting shed enclosures, and residential soundproofing. Thal-Asc.
- ***Waterford Gun Range, Waterford, ME (MMX)*** – Performed an evaluation of noise generated by an existing range as a potential noise trespass impact at a residence approximately one mile away. Ambient and gun noise levels were measured and recorded at the residence location. Current conditions were then

simulated in the Cadna-A model in order to develop candidate mitigation options and evaluate their noise reduction effectiveness. Partial enclosures (shooting sheds) were recommended for the pistol and rifle ranges as well time restrictions for shotgun activities. A legal deposition as an **expert witness** was provided in support of community objections to the range. Thal-Asc.

- ***Headwaters Gun Range, Bemidji, MN (MMVIII)*** – Performed a gun noise evaluation of a proposed combination rifle, pistol and shotgun range in Bemidji, MN. Firearm noise emission levels were taken from measurements performed on previous projects, and noise levels were predicted at property lines and nearby residential receptors using the Cadna-A environmental noise model. Noise levels were evaluated against the Minnesota Shooting Range Protection Act and Minnesota Administrative Rule 7030 for compliance. Thal-Asc.
- ***Nantucket Hunting Association, Nantucket, MA (MMVII - MMXVI)*** – Performed a comprehensive noise study for a proposed gun range on Nantucket Island. The study involved live firing of multiple rifles, pistols and shotguns from the proposed range location, and measuring and evaluating the noise levels in neighborhoods surrounding the range. Empirical gunfire noise propagation models and contour maps were developed, which were followed by hypothetical gun noise modeling using Cadna-A. The results indicated compliance with the Nantucket Noise Bylaw and questioned the applicability of Mass DEP Policy 90-001 (310 CMR 7.10). Rebuttals were prepared to refute the opposition’s acoustical experts. The results of the study were presented at the Nantucket Zoning Board of Appeals. Performed an updated live gunfire noise measurement test focusing on Wigwam Road, and provided **expert witness** courtroom testimony in Land Court (Case No. 476822) in November 2016. Thal-Asc.
- ***ConnDOC Cheshire Facility Gun Range, Cheshire, CT (2006)*** – Performed an acoustical analysis and recommended mitigation measures to control gunfire noise emanating from the Connecticut Dept. of Correction’s Maloney Training Center. Noise measurements were performed inside the range as well as at several residential receptors surrounding the range. Empirical noise propagation models were developed based on the measurements, and the subjective reaction of the community was evaluated in a series of survey questionnaires. Parsons Brinckerhoff.
- ***Moon Island Firearms Range Noise Study, Seaside Alliance, Boston Harbor, MA (1994)*** - Reviewed and commented on previously performed noise impact regarding the proposed expansion of a Boston Police/DEA firearms training facility. Thal-Asc.

12.) HUMAN VIBRATION PROJECTS:

- ***Residential Vibrations Evaluation, 62 Speen Street, Natick, MA (MMXIX)***– Performed vibration tests inside and outside of a private residence to quantify and evaluate concerns of the homeowner caused by traffic passing by in close proximity to the house. Streamed two channels of vibration accelerometer data into a Sinus SoundBook for three days and reduced the data into vibration velocity levels in VdB and PPV. Evaluated the results against criteria guidelines for both human annoyance to vibration and potential physical damage to the property. Thal-Asc.
- ***Iverson Residence Vibration Annoyance Study, Boston, MA (MMXII)*** – Performed tri-axial vibration measures inside handicapped residence to evaluate severity of vibration resulting from downstairs neighbor activity. Reduced and evaluated results per 2006 FTA Manual’s VC-curve criteria as well as ISO Standard 2631 for Reduced Comfort. Also recommended and provided guidance on selection of vibration isolator springs (Korfund CCA8-1) to be placed under the resident’s bedposts. Thal-Asc.
- ***Zimmer Residence Noise and Vibration Annoyance Study, Thompson, PA (MMXI)***– Performed extensive tri-axial vibration measurements and noise measurements in basement, first and second floor of residence to evaluate potential impacts from nearby oil/gas drilling/fracking operation. Reduced and evaluated vibration results per 2006 FTA Manual’s VC-curve criteria as well as ISO Standard 2631 for Reduced Comfort, and evaluated noise results in accordance with US EPA and ASHRAE guidelines. Thal-Asc.
- ***WMATA Distressed Properties Evaluation, Washington, DC (2005)***– Performed noise, vibration and light evaluations of two residences for potential adverse effects from Washington Metro transit train operations. Measurements were performed both outside and inside the residences with the results reduced and evaluated against a variety of relevant criteria limits such as those promulgated by WMATA, FTA, APTA, HUD, BoM, ANSI Std. S3.29 and Swiss SN 640312. The results indicated that while WMATA train noise and vibrations may be noticeable inside the residences, the levels did not exceed any criteria limits for annoyance, minor or major structural damage. Parsons Brinckerhoff.
- ***North End Building Vibration Mitigation Program, Central Artery / Tunnel Project, Boston, MA (2000)*** - In reaction to community complaints about annoying building vibrations, oversaw a comprehensive human vibration study conducted by HMMH in accordance with ANSI S3.29 to identify the vibration source and develop possible mitigation options. Subsequently performed a series of quantitative tests to reduce community vibrations by reducing traffic speeds on the nearby elevated Interstate I-93 Highway. Eventually recommended and implemented grinding smooth (scarifying) the roadway surface and the provision of vibration isolator springs under residents' bedposts. Developed eligibility criteria to award isolator springs and/or reinforced bed frames through the CA/T Vibration Annoyance Mitigation Policy (12/1/00). Parsons Brinckerhoff.
- Presented two day training seminar entitled: ***Human Exposure to Occupational Whole-Body and Hand-Arm Vibration*** at the U.S. Navy Occupational Health and Preventive Medicine Workshop, Virginia Beach, VA, February 1997. Training included classroom lecture material and hands-on training involving H-A vibration from power hand tools and W-B vibrations in a moving bus. Thal-Asc.
- Paper and Publication: ***Practical Approach to the Measurement and Evaluation of Exposure to Whole-Body Vibration in the Workplace***, presented at the 1996 Pregnant Women in the Workplace Conference, University of Florida at Gainesville, FL, and published in Seminars in Perinatology Journal, April 1996, by W.B. Sanders Publishers Company. Thal-Asc.
- ***American Industrial Hygiene Association, St. Louis, MO*** - Performed seminar on **Human Exposure to Vibration**, demonstrated instrumentation and technique to show attendees. Bruel & Kjaer.
- Performed one day seminar entitled ***Human Exposure to Vibration*** to national attendees in St. Louis, Burlington, Gainesville, Boston, Chicago, etc. Bruel & Kjaer.

- **Elevator Ride Comfort**, *Otis Elevator, Hartford, CT (1987)* - Recommended and demonstrated various human vibration instrumentation and measurement techniques. Bruel & Kjaer.
- **Interception Craft Ride Comfort**, *U.S. Coast Guard, Governors Island, NY (1987)* - Trained and demonstrated appropriate use of human vibration equipment to assess ride comfort onboard fast-moving interception boats. Bruel & Kjaer.
- **Measurement of Visco-elastic Material**, *Sorbothane Corporation, Kent, OH (1987)* - Recommended and developed human vibration measurement assessment of visco-elastic product. Bruel & Kjaer.
- **National Institute of Occupational Safety and Health (NIOSH)**, *Cincinnati, OH (1987)* - Appeared in revised national training video (#178) detailing human vibration, performed as guest speaker at three day NIOSH course entitled *Human Exposure to Occupational Vibration*. Bruel & Kjaer.
- **Tool Hand-Arm Vibration Measurements**, *Chicago Pneumatic, Utica, NY (1987)* - Trained and recommended appropriate instrumentation for assessing hand tool vibration severity. Bruel & Kjaer.
- **Compressed Air & Gas Institute (CAGI)**, *Cleveland, OH (1987)* - Trained and recommended appropriate measurement technique for assessing hand tool vibration severity. Consulted for CAGI Standards Committee. Bruel & Kjaer.
- **Power Tool Institute (PTI)**, *Cleveland, OH (1986)* - Trained and recommended appropriate measurement technique for assessing hand tool vibration severity. Consulted for PTI Standards Committee. Bruel & Kjaer.

13.) PRODUCT TESTING NOISE & VIBRATION PROJECTS:

- ***Gun Silencers dBZ Peak Comparison Tests, Discreet Ballistics, Plainfield, NH (MMXVIII)*** – Performed a series of controlled acoustical tests to evaluate several dozen large bore (300BLK) and small bore (22LR) caliber rifle silencers (suppressors) in accordance with MIL-STD 1474D. Performed dBZ Peak sound level measurements with six different sound level meters to evaluate the noise reduction performance of the silencers. Sound level meters included a Svantek Model 971, CEL Model 593, Larson Davis Model LxT, Larson Davis Model 720, and two Bruel & Kjaer Model 2209 sound meters. The best-performing silencers were able to reduce gunshot sound levels by 35 decibels. Thal-Asc.
- ***Wing Delivery Drone Noise Support, Google Wing, Palo Alto, CA (2019)*** – Extending on similar acoustical work done by WSP in Australia, performed acoustical training and quantifying support for Wing's development of delivery drones. Performed flyby noise measurement tests of production and prototype drones at Wing's test facility in Hollister, California. Flyby noise level were measured using three Svantek 971 sound meters at various traverse distances and the results were reduced in accordance with 14 CFR Appendix J to Part 36, Section J36.205 and ICAO Annex 16. Parsons Brinckerhoff.
- ***Car Wash Dryer Blower Silencers, Sonny's Car Wash, Tamarac, FL (2018)*** – Retained by a large manufacturer of car wash equipment tunnels to aid them in measuring and reducing noise emissions from their dryer blowers. Performed several series of controlled acoustical tests of various prototype dryer silencers and blower nozzles. Parsons Brinckerhoff.
- ***Holmes Products Noise Comparison Tests, Holmes Products, Waltham, MA (1995)*** - Performed comparative noise emissions tests on air humidifiers and purifiers manufactured by Holmes Products vs competitive makes and models. The results of the objective noise tests aided Holmes Products with marketing efforts. KM Chng Environmental.
- ***Seismic Vibration Testing of OIS-41 Critical Equipment, Bailey Controls, Burlington, MA (1993)***- Oversaw and organized seismic vibration shaker testing of a large 400 lb electronic console controller to be used by Alyeska in the Alaska pipeline. Atlantic Applied Research.
- ***Sound Power and Sound Pressure Tests for Stratus Computers, Marlboro, MA (1992)*** - Performed sound power level and sound pressure level measurements per ANSI S12.10 and ISO 7779 on two prototype mainframe computer systems utilizing AARC's anechoic chamber and automated test equipment. Atlantic Applied Research.
- ***Elevator Ride Comfort, Otis Elevator, Hartford, CT (1987)*** - Recommended and demonstrated human vibration instrumentation and measurement technique. Bruel & Kjaer.
- ***Automobile Thermal Comfort, Ford Motor Company, Testing Grounds, NM (1988)*** - Recommended and trained appropriate use of indoor thermal comfort measurement instrumentation. Bruel & Kjaer.
- ***Aberdeen Proving Grounds, Aberdeen, MD (1988)***- Recommended and trained appropriate use of sound level meters and light meters. Bruel & Kjaer.
- ***Stun Grenades Noise Tests, Los Angeles Police Dept., Los Angeles, CA (1986)*** - Developed sound level meter/hydrophone system capable of measuring stun grenade noise levels. Bruel & Kjaer.
- ***Measurement of Visco-elastic Material, Sorbothane Corporation, Kent, OH (1987)*** - Recommended and developed human vibration measurement assessment of visco-elastic product. Bruel & Kjaer.
- ***Light Fixture Development Testing, Philips Lighting Co., Lynn, MA (1988)***- Recommended and trained in use of photometer for use in developing new florescent fixtures. Bruel & Kjaer.
- ***Light Bulb QC Testing, GTE Sylvania, Danvers, MA (1988)***- Developed a vibration response testing system

to identify broken light bulbs for a Quality Control testing procedure. Bruel & Kjaer.

- ***Glass Jar QC Testing, Ragu Foods Corporation, Marlboro, MA (1987)*** - Developed a vibration response testing system for glass food jars to be used during a Quality Control testing procedure. Bruel & Kjaer.
- ***Flashlight Development, Rayovac Corporation, Madison, WI (1988)*** - Trained and recommended appropriate photometric instrumentation for light intensity measurements. Bruel & Kjaer.
- ***Human Factors Studies, Cornell University, Ithaca, NY (1988)*** - Recommended and demonstrated noise, light and thermal instrumentation for new human factors research laboratory. Bruel & Kjaer.
- ***Car Stereo Wars Judge, Tweeter Etc., Amherst, MA (1984)*** - Judged a "Car Stereo Wars" promotion with noise measurements performed inside applicant's vehicles. University of Massachusetts.

14.) INTERIOR ARCHITECTURAL ACOUSTICS PROJECTS:

- ***Kruger Packaging HVAC Noise***, *Kruger Packaging, Elizabethtown, KY, (2023)* – Planned, oversaw and reduced data in an assessment of interior ventilation noise for a packaging factory stemming from employee complaints. Noise and vibration measurements were performed inside the facility and on the rooftop. The sound power level of an example Cook upblast exhaust fan was tested in accordance with ISO Standard 3744. Direct sound levels, NC and RC curves, and structure-borne noise levels were computed. Recommendations were provided to reduce excessive fan noise inside the facility. Parsons Brinckerhoff.
- ***NJT Central Concourse***, *New Jersey Transit Authority, Penn Station New York, NY (2022)* - Performed an acoustical evaluation of the proposed design for a brand new central rail concourse in Penn Station. The evaluation included performing ambient noise and similar concourse interior noise measurements, modeling the concourse's HVAC system noise using the AIM model, and simulating the concourse's architectural acoustics conditions using the Cadna-R model. The results were evaluated against ANSI Standard S12.2 and ASHRAE guidelines for HVAC noise, NFPA-130 guidelines for emergency ventilation noise, and a Speech Transmission Index (STI) of 0.45 to ensure adequate public address speech intelligibility for patrons and understanding of emergency messages. Parsons Brinckerhoff.
- ***Metropolitan Club Noise Intrusion***, *Metropolitan Club, New York, NY (2021)* - Recommended technical approach for evaluating noise levels inside Metropolitan Club produced by adjacent HVAC equipment for the Pierre Hotel. Reduced the interior sound data measured by others inside the Club. Evaluated the results against the New York City Noise Control Code Section 24-227 limiting HVAC equipment noise not to exceed 42 dBA at a location 3 feet inside a receiving residential property with the windows open. Parsons Brinckerhoff.
- ***Accenture Office Building WELL Certification***, *Accenture, PLC, New York, NY (2021)*– Reduced office space sound level measurement data to compute octave band Noise Criteria (NC) and Noise Rating (NR) results to evaluate compliance with WELL building certification standards. Parsons Brinckerhoff.
- ***NAVFAC Pharmacy Waiting Area Acoustical Design***, *US Naval Facilities Engineering Command, Portsmouth, VA (2020)* – Performed interior acoustical analysis for the NAVFAC Building 2 pharmacy waiting area as part of a restoring finishes project. The goals were to (1) ensure acoustical conditions in the waiting room will be suitable to provide intelligible speech between pharmacists and patients at the counter windows, and (2) ensure the pharmacists and patients speech is not easily understood by people in the waiting area in adherence with Health Insurance Portability and Accountability Act (HIPAA) speech privacy considerations. Used the Cadna-R model to simulate waiting room interior noise levels due to people talking, HVAC system noise, and the effects of the selected finish materials. Selected a goal of STI 0.6 or better for pharmacist-patient conversations taking place at the counter windows, and an STI 0.3 or worse for people seated in the waiting area. Parsons Brinckerhoff.
- ***University of New Hampshire HVAC Noise***, *Colden Corporation, Durham, NH (MMXIX)*– Assisted with the assessment of HVAC noise complaints from inside a laboratory space at UNH. Reduces sound spectra measurements to identify potential source and recommended methods to reduce HVAC noise involving duct wrap lagging. Thal-Asc.
- ***AFGA Printing Operations Noise Transfer***, *Colden Corporation, Andover, MA (MMXIX)* – Predicted the levels of noise that might transfer to adjacent and upper floor spaces associated with printing/plotting operations if AFGA were to sublet space in a building. Used vendor specifications to estimate the sound level produced by the printing machines and the INSUL model to estimate wall and ceiling sound transmission loss. Thal-Asc.
- ***Carr Residence Acoustical Guidance***, *Wayland, MA (MMXIX)*– Provided recommendations and guidance to homeowner while building a new residence in which sound quality was highly desired. Provided suggestions and vendor sources for wall and ceiling enhancements, HVAC sound control and speech

privacy in offices. Thal-Asc.

- **Wayland School of Music, Wayland, MA (MMXIX)** – Assisted with the evaluation of potential new buildings to expand the music school. Evaluated sound reduction through demising wall using INSUL model, recommended several methods to improve low frequency transmission loss between adjacent spaces. Thal-Asc.
- **6 Clarendon Street Rooftop HVAC Noise, Boston Proper Real Estate, Boston, MA (2019)** – In reaction to occupant complaints, performed an assessment of interior noise levels caused by the operation of eight rooftop HVAC units of a brownstone condo building. Interior noise levels were evaluated against recommended Noise Criteria (NC), Room Criteria (RC) and A-weighted sound levels for a residential dwelling. Recommendations were provide to reduce noise intrusion from the rooftop HVAC units focusing on vibration isolation and control. Parsons Brinckerhoff.
- **Haley-Henry Wine Bar, The Abbey Group, Boston, MA (2018)** – Hired by the building’s property manager to evaluate noise complaints in a luxury condominium located above a wine bar in the Beacon Hill area of Boston. Performed noise levels measurements inside the wine bar during its busy operations as well as in the condo above. Computed the noise reduction, STC, NC, RC and contribution of bar noise infiltrating the condo, and evaluated the results against the City of Boston Entertainment License Regulation. Recommended several source and pathway noise control options for management’s consideration. Parsons Brinckerhoff.
- **717 Atlantic Avenue Soundproofing, Boston, MA (MMXVIII)** – Evaluated a condominium unit for potential soundproofing improvements due to excessive noise produced by traffic along Atlantic Avenue and rail yard noise from MBTA South Station. The condo unit was renovated from an old cold storage building and had concrete floors and a brick ceiling. Recommended interior sashes to augment existing thermal windows. Thal-Asc.
- **AEW Capital Building WELL Certification, Cashins Associates, Wakefield, MA (MMXVII)** – Supported another consultant with the measurement and evaluation of interior noise levels for a new office building with respect to compliance with WELL Standard Feature 75 for interior HVAC noise. The WELL guideline required evaluation of the Noise Criteria (NC), as defined in ANSI Standard S12.2, inside various spaces within the building. Thal-Asc.
- **Soapbox Gallery Sound Isolation, Brooklyn, NY (MMXVI)** – Supported the development of a new arts and music gallery being built in a restored building. Provided general acoustical guidance regarding sound quality for live entertainment, and specific analysis using the INSUL model to recommend improved sound insulation between adjacent units. Thal-Asc.
- **Libbie Mill Condos Acoustical Gap Review, HKS Architects, Henrico, VA (2016)** – Performed a technical gap assessment and peer review for a new multi-building, multi-story condominium complex to be built in Henrico County, VA. Architectural aspects examined included (1) exterior walls and roof noise insulation, (2) interior walls and floor/ceiling speech privacy, (3) mechanical equipment noise isolation, (3) HVAC noise and vibration control, (4) plumbing systems noise control, and (5) the audibility of PA and fire alarm systems. Parsons Brinckerhoff.
- **LaGuardia Airport Air Traffic Control Tower, Skanska/Walsh JV, New York, NY (2016)** – Performed a special study at the request of the Federal Aviation Administration (FAA) to assess potentially dangerous communication interruptions for air traffic controllers caused by construction near the tower. Performed an hour of simultaneous noise measurements inside and outside the control tower to establish control tower facade’s noise reduction properties. Predicted construction noise from pile driving, vac-truck excavators and hoe rams to the exterior of the tower using the Cadna-A model, and then used the measured noise reduction to predict interior noise conditions. Evaluated potential for speech interference using the Articulation Index from ANSI S3.5. Determined that both male and female control operators could maintain good speech intelligibility (i.e. AI \geq 0.8) speaking in a loud tone of voice. Control operators

would not need to shout to be understood. Parsons Brinckerhoff.

- ***Mass Rifle Summa Range Acoustics, Massachusetts Rifle Association, Woburn, MA (MMXVI)***– Performed an acoustical assessment of potential consequences associated with installing a large ventilation unit over the outdoor rifle range shooting area. Modeled existing and future reverberation times (RT60) of the range to see if future reverberant conditions would pose a concern for speech intelligibility. Recommended mitigating options including lining the shooting area walls and ceiling with Pyrok acoustical absorptive material. Thal-Asc.
- ***Chicago Hancock Tower Interior Noise Control, 175 East Delaware Place Homeowners Association, Chicago, IL (MMXIV)*** – Hired by residents association to provide guidance and recommendations to improve intra-unit noise control and privacy of luxury condominiums in the Chicago Hancock Tower. Provided acoustical tutorial, researched relevant interior noise guidelines and standards, estimated STC and IIC of existing wall and floor/ceiling construction, and developed a Building Interior Construction Noise Specification to manage future new construction and renovation noise. Thal-Asc.
- ***Residential Invasive Sound Study, Francis/Gates Residence, Waltham, MA (MMXIII)*** – Performed a residential sound study for a hard of hearing couple to measure and evaluate low frequency music and other noise being produced by upstairs neighbors. Collected long-term unattended noise data and recording, had residents log time and description of objectionable noise events, researched relevant indoor noise criteria, and presented results showing excessive impacts of the Waltham Noise Code. Thal-Asc.
- ***Condominium Rooftop Ventilation Fan Noise Control, Greater Boston Properties, Boston, MA (MMXIII)***– Performed a noise and vibration analysis of a restaurant ventilation fan located on a condominium rooftop at 533 Columbus Avenue. The fan was generating significant low frequency noise inside the building and giving residents headaches and nausea. Interior noise measurements were evaluated against recommended dBA, NC and RC criteria, and vibration measurements on the fan and building were evaluated for possibly causing structural damages. It was concluded that the low frequency noise problem was due to structure-borne noise so the vibrating rooftop fan was mitigated by relocating it onto the building's structural members, making better use of vibration isolator springs, installing a variable speed drive, and most importantly, rebalancing the fan. The results revealed a remarkable reduction virtually eliminating the interior low frequency noise problem. Thal-Asc.
- ***Rooftop HVAC Units Noise and Vibration Control, Johnson Controls, Wareham and Canton, MA (2012)*** - Performed noise and vibration assessment for two buildings in which interior noise conditions were considered unacceptable due to the presence of multiple rooftop mounted HVAC units. Performed existing conditions noise and vibration measurements and recommended means of reducing noise and vibration via vibration isolation curbs, improved air duct positions and vanes, duct lagging enclosures, and roof enhancement. The results inside affected top floor conference rooms were evaluated using NC criteria per ANSI Standard S12.2 and RC criteria per ASHRAE guidelines. Parsons Brinckerhoff.
- ***Hopkinton Sportsmens OSHA Noise Compliance Test, Hopkinton, MA (MMXII)*** – Performed noise measurements in waiting area proximal to an indoor shooting range for the purpose of evaluating potential hearing damage concerns for spectators. Measured gun fire noise levels for several hours and evaluated the results against Leq-Dose criteria in accordance with OSHA noise guidelines in 29 CFR Part 1910.95. Thal-Asc.
- ***Windsor Locks Readiness Center, US National Guard, Windsor Locks, CT (2011)***- Performed all acoustical services in support on the design of a new National Guard Readiness Center located at Bradley International Airport. Performed ambient and specific source noise measurements in order to recommend suitable exterior building facade and windows. Particularly loud noise sources to accommodate included Blackhawk (UH-60) and Chinook (CH-47) helicopters. Reviewed contractor submittals to ensure interior doors and partitions were in compliance with project specifications. Parsons Brinckerhoff.

- ***US Marines Auditorium Design, US Marine Corps, Camp Lejeune, NC (2011)*** – Performed reverberation time calculations and evaluation of newly construction Applied Instruction Facility lecture/training center at Camp Lejeune, advised construction managers of acoustical criteria and required performance specifications, successfully recommended a more appropriate reverberation time requirement of 1 second in 500 Hz octave band for the lecture hall which will seat 450 marines, provided recommendations for additional acoustical absorption if space requires. Parsons Brinckerhoff.
- ***Cloonan School Auditorium Acoustics Evaluation, Stamford, CT (MMIX)*** – Performed reverberation time measurements inside the auditorium of the Cloonan Middle School prior to the auditorium being renovated. Evaluated proposed replacement acoustical absorption materials to ensure that the renovated auditorium will have similarly desirable acoustical conditions. Thal-Asc.
- ***City of Stamford Police Department Gun Range Noise Control, Stamford, CT (MMV)*** – Performed a study of the propagation of gunfire noise throughout the building resulting from the use of officers training with handguns, rifles and shotguns in the basement gun range of the Stamford Police Department building. Gun noise levels were measured to determine loudness and transmissibility through walls and ceilings/floors, and reverberation times were measured inside the range and adjacent ready room. A comparison of available interior acoustical absorption treatments was conducted, and recommendations were provided to reduce the gun noise both inside the range as well as throughout the rest of the building. Follow-up noise measurements were performed after the City renovated the range. Thal-Asc.
- ***National Guard Armory Building, Natick, MA (MM)*** - Performed an interior acoustics assessment of a large reverberant armory building (230,000 cu.ft.) which is planned to be used for functions associated with the Town of Natick's 350th Anniversary. Reverberation time models using Sabin's methods were developed to simulate the space's existing acoustic properties, and options for various additional sound absorptive treatments were evaluated. Recommendations for treatments and costs were developed and presented to Town organizers with the goal of achieving a more appropriate acoustic environment for the intended functions. Thal-Asc.
- ***Notch Welding & Contracting Noise Survey, Chicopee, MA (1991)*** - Performed occupational noise survey for MEIE insurance and employee safety purposes. Noise measurements led to recommendations for controlling excessive metal shop related activity noise. Atlantic Applied Research.
- ***NECCO Candy Factory Reverberation Tests, Cambridge, MA (1990)*** - Performed candy factory interior reverberation tests using an automated reverberation time noise analyzer (B&K 2231) in order to advise noise absorption treatments. Bolt Beranek & Newman, Acentech.
- ***Veterans Administration Hospital, West Roxbury, MA (1982)*** - Performed vibration measurements to certify that the installation of new air conditioner fan units complied with the manufacturer's specifications. Cavanaugh Tocci Associates.
- ***Boston Museum of Science, Boston, MA (1982)*** - Performed ambient noise study in an effort to improve interior acoustic conditions. Cavanaugh Tocci Associates.
- ***Office Building, Marlboro, MA (1982)*** - Performed interior octave band spectral measurements to determine interior NC ratings. Cavanaugh Tocci Associates.

15.) UNDERWATER HYDRO-ACOUSTICS PROJECTS:

- ***NSN Baseline Underwater Noise Monitoring, US Naval Shipyard, NAVFAC, Norfolk, VA (2023)*** – Performed baseline underwater noise measurements at two locations surrounding Norfolk naval shipyard in anticipation of future construction to be performed on the docks and piers. RESON TC-4033 hydrophones were used to monitor ambient sound levels for three-day periods in each quarter of the year in accordance with NOAA Guideline: Data Collection Methods to Characterize Underwater Background Sound Relevant to Marine Mammals in Coastal Nearshore Waters. Parsons Brinckerhoff.
- ***Walk Rail Bridge Replacement, Connecticut Department of Transportation, Norwalk, CT (2018)***– The Walk Bridge, which crosses the Norwalk River as part of Amtrak’s Northeast Corridor, is being replaced with a new bridge. In response to community concerns about potentially adverse effects associated with construction of the new bridge, a comprehensive Construction Noise and Vibration Control Program was proposed for CTDOT’s consideration to implement. Of particular concern were potential adverse impacts to endangered sea creatures (harbor seals and sea turtles) at the nearby Maritime Aquarium. Existing conditions were measured, and future potential conditions were predicted for air-borne noise and ground-borne vibration affecting aquarium staff and visitors, and for hydro-acoustic noise levels inside several of the aquarium’s water tanks. Later, noise, vibration and hydro-acoustic levels affecting the Aquarium and its endangered species were monitored during a month-long pile driving test program (TPP) involving nine test pile sites and four different pile drivers. Parsons Brinckerhoff.
- ***Great Egg Harbor Bridge Project, New Jersey Department of Transportation, Marmora, NJ (2014)*** - Oversaw implementation of the project’s underwater noise monitoring program in order to protect Atlantic sturgeon and sea turtles from pile driving noise that might adversely affect their reproductive patterns or potentially fatally harm them. Received raw data as wave files from field staff, reduced, analyzed and evaluated the results. Parsons Brinckerhoff.
- ***Manahawkin Bay Bridge Project, New Jersey Department of Transportation, Ocean County, NJ (2013)*** - Developed the Underwater Construction Noise Specification for the project in order to protect Atlantic sturgeon and sea turtles from pile driving noise that might adversely affect their reproductive patterns or potentially fatally harm them. Codified the acoustical performance requirements for an underwater bubble curtain and for pile cap cushions. Performed underwater noise measurements using a hydrophone to ensure contractor compliance with specification limits. Parsons Brinckerhoff.

16.) ENGINEERING SEMINARS & PRESENTATIONS:

- ***Understanding and Applying OSHA's Noise Control Policy***, OSHA New England Roundtable Online Series, (MMXXII). Thal-Asc.
- ***Human Exposure to Vibration***, OSHA New England Roundtable Online Series, (MMXXI). Thal-Asc.
- ***Tech Jams***, WSP AVAQ Acoustics Group, Virtual Presentations – Organized and presented a series of technical training webinars on various topics of noise, vibration, measurements, modeling, and controls to share knowledge within the company. Parsons Brinckerhoff.
- ***Highway Noise and TNM Model Training***, WSP AVAQ Acoustics Group Meeting, Orlando, FL – Presented fundamentals of highway noise assessment, measurement, modeling and control to the junior acoustical staff. Parsons Brinckerhoff.
- ***GOAL Gun Range Community Noise Seminar***, Gun Owners Action League (GOAL), Maynard, MA (MMXVIII) – Performed a seminar on 9/16/18 as part of GOAL's Outdoor Range Seminar Series describing community noise concerns and assessment methods. Attendees included representatives from more than 40 public and law enforcement shooting ranges in Massachusetts. Thal-Asc.
- ***Curious Challenges Controlling Construction Noise***, presented at Wentworth Institute of Technology's Curious Annex Lecture Series, November 2016. Thal-Asc.
- ***Quieting the Impact of Transportation with Sound Acoustical Planning***, presented and published at the Association for Environmental Health and Sciences (AEHS) 2016 Conference, Amherst, Massachusetts, October 2016. Parsons Brinckerhoff.
- ***Fan Manufacturer Sound Power Data – Trust But Verify***, presented and published (Paper No. 017) at Noise-Con 2016, Providence, Rhode Island, June 2016; and in Sound & Vibration Magazine, February 2017. Parsons Brinckerhoff.
- ***Development and Implementation of an Underwater Construction Noise Program***, presented and published (Paper No. 120) at Noise-Con 2014, Ft. Lauderdale, Florida, September 2014. Parsons Brinckerhoff.
- ***Acoustical Fundamentals and Noise Measurements*** training seminar performed for Boston Environmental Department inspectors responsible for enforcing the City of Boston Noise Code. Parsons Brinckerhoff.
- ***InterNoise 2012 Conference Opening Plenary Speech***, New York City, NY (2012) – Performed the opening plenary speech in conjunction with NYC DEP staff to 1,500 conference attendees describing the history, development, requirements and implementation of the 2007 New York City Construction Noise Regulation. Parsons Brinckerhoff. <http://youtu.be/pytuehFADMO>
- ***New York City Construction Noise Regulation***, New York City, NY (2011) – Performed a telecast webinar sponsored by the ACEC NYC Chapter, followed by a live presentation at Parsons Brinckerhoff's headquarters summarizing the development, contents, noise limits, implications, and means and measures for compliance for the NYC DEP Construction Noise Regulations. Presented in conjunction with NYC DEP staff. Attendees earned 1.0 PDH professional development credits. Parsons Brinckerhoff.
- ***Noise for Civil Engineers***, Tufts University, Somerville, MA (2006, 2007) – Invited lecturer at Tufts University to present a class to civil engineering students regarding the importance of noise control and interdisciplinary coordination in construction management. Parsons Brinckerhoff.
- ***History of Sonic Arts***, School of the Museum of Fine Arts, Boston, MA (MMIV) – Performed a class at the Boston Museum of Fine Arts as an invited lecturer for students pursuing their degrees in art and music.

The class material focused on the definitions, metrics and descriptions of noise, the various noise criteria promulgated by federal, state and local agencies, instrumentation used to measure noise, and how human beings perceive and respond to noise. Thal-Asc.

- **FHWA National Construction Noise Policy and Procedure**, Volpe Center, Cambridge, MA (2003) – Participated on team scoped to update the national construction noise policy and assessment procedure for all FHWA-funded projects. The new RCNM policy and prediction model will in large part be based on the successful construction noise control experiences gained at the Central Artery/Tunnel Project. Parsons Brinckerhoff.
- **FHWA Technology Transfer Presentations** Central Artery/Tunnel Project, Boston, MA (2001, 2003) – Several presentations were made to FHWA and other State DOT representatives detailing the lessons learned and best mitigation practices of the CA/T construction noise control program. FHWA staff then disseminated the information to other Federally-funded transportation projects with the recommendation that they adopt similarly effective noise mitigation programs. Parsons Brinckerhoff.
- **Admiral Lewis B. Combs Design Retreat**, Rensselaer Polytechnic Institute, Boston, MA (2000-2004) - Presented an overview of the CA/T Project's construction noise control program to a group of advanced RPI engineering students who were visiting the project for a summer design retreat. Noise-related questions were developed and students were allowed to present their answers in a group format. Parsons Brinckerhoff.
- Conducted training course for field staff and inspectors entitled: **Construction Noise Control** as part of role as technical lead for the Central Artery/Tunnel Project in Boston, MA. Attendees were instructed how to recognize, measure, evaluate, and control CA/T-induced construction noise. Parsons Brinckerhoff.
- Presented two day training seminar entitled: **Human Exposure to Occupational Whole-Body and Hand-Arm Vibration** at the 1997 U.S. Navy Occupational Health and Preventive Medicine Workshop, Virginia Beach, VA. Students were taught how to recognize, measure, evaluate and control hand-arm and whole-body vibrations. Live demonstrations of measurement techniques were performed on a variety of hand tools and while riding on a small bus. Thal-Asc.
- Paper and Publication: **Practical Approach to the Measurement and Evaluation of Exposure to Whole-Body Vibration in the Workplace**, presented at the 1996 Pregnant Women in the Workplace Conference, University of Florida at Gainesville, FL, and published in Seminars in Perinatology Journal, April 1996, by W.B. Sanders Publishers Company. Thal-Asc.
- Performed three day seminar entitled **Acoustic Noise Control** to national attendees. Seminar performed in San Francisco, Atlantic City, Washington, D.C., Los Angeles, Orlando, etc. Bruel & Kjaer.
- Performed one day seminar entitled **Environmental Noise Measurements** in Boston. Bruel & Kjaer.
- Performed one day seminar entitled **Basic Acoustics & Basic Vibration** in Boston, Hartford. Bruel & Kjaer.
- Performed one day seminar entitled **Human Exposure to Vibration** to national attendees in St. Louis, Burlington, Gainesville, Boston, Chicago, etc. Bruel & Kjaer.
- Performed dual half day seminars entitled **Measuring Light & Thermal Environments** to national attendees in Gaithersburg, West Caldwell, Boston, Los Angeles, San Francisco, Cleveland, etc. Bruel & Kjaer.
- Performed **sales staff training** and environmental instrumentation demonstrations in Boston, Los Angeles, Copenhagen, and at other sales organization meetings. Bruel & Kjaer.
- **American Industrial Hygiene Association, St. Louis, MO** - Performed seminar on **Human Exposure to Vibration**, demonstrated instrumentation and technique to show attendees. Bruel & Kjaer.

- **Measurement Demonstrations**, *Acoustic Society of America, Miami, FL* - Performed sales and measurement demonstrations as an exhibitor at ASA annual conference. Bruel & Kjaer.
- **National Institute of Occupational Safety and Health (NIOSH)**, *Cincinnati, OH* - Appeared in revised national training video (#178) detailing human vibration, performed as guest speaker at three day NIOSH course entitled *Human Exposure to Occupational Vibration*. Bruel & Kjaer.
- **Compressed Air & Gas Institute (CAGI)**, *Cleveland, OH* - Trained and recommended appropriate measurement technique for assessing hand tool vibration severity. Consulted for CAGI Standards Committee. Bruel & Kjaer.
- **Power Tool Institute (PTI)** - Trained and recommended appropriate measurement technique for assessing hand tool vibration severity. Consulted for PTI Standards Committee. Bruel & Kjaer.
- **Teaching Assistant** to Professor George Albert Russell during Senior Mechanical Vibrations Course, fall semester 1984. University of Massachusetts, Amherst, MA.