AMEC FOSTER WHEELER

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Abstract

Amec Foster Wheeler is a global consulting engineering company that employs over 40,000 people in more than 55 countries. The Acoustic Centre of Expertise is a group within Amec Foster Wheeler that supports acoustics, noise and vibration engineering services. We are based out of the Mississauga, Ontario, Canada and support projects throughout North and South America. Our expertise includes environmental noise, transportation noise, building acoustics, vibration and monitoring in support of our oil and gas, clean energy, environmental and infrastructure and mining markets.

Keywords: environmental noise, transportation noise, building acoustics, vibration, noise measurements, noise monitoring, vibration measurements, vibration monitoring, oil and gas, clean energy, environmental, infrastruture, mining

Résumé

Amec Foster Wheeler et une entreprise de consultation et ingénierie qui emploie 40 000 employés œuvrant dans plus de 55 pays. Au sein d'Amec Foster Wheeler est le Centre d'Expertise en acoustique qui soutient services d'ingénierie dans les domaines de l'acoustique, du bruit et des vibrations. Nous sommes établis à Mississauga, en Ontario Canada et on soutien de projets à travers l'Amérique du Nord et du Sud. Notre expertise comprend les domaines du bruit ambiant, le bruit des infrastructures de transport, l'acoustique du bâtiment, la surveillance et les vibrations en appui de nos secteurs du pétrole et du gaz, de l'énergie propre, de l'environnement et des infrastructures et des mines.

Mots clefs : bruit dans l'environnement, bruit des infrastructures de transport, acoustique du bâtiment, vibrations, mesures de bruit, contrôle du bruit, mesures de vibrations, contrôle des vibrations, pétrole et du gaz, énergie propre, l'environnement, infrastructures, exploitation minière

1 Introduction

Amec Foster Wheeler designs, delivers and maintains strategic and complex assets for its customers across the global energy and related sectors. We design, deliver and maintain strategic and complex assets and employ around 40,000 people in over 55 countries worldwide.

Our operation spans across four key markets: Oil & Gas, Mining, Clean Energy, and Environment & Infrastructure. In each market, the range of services provided to our customers is very similar and runs right across the lifecycle of assets. Our engineering and project management activities are managed by four business units: Americas, Northern Europe & CIS (NECIS) and Asia, Middle East, Africa & Southern Europe (AMEASE) and Global Power Group (GPG). We are proud of our core values: delivering on promises, developing full potential and doing the right thing. Amec Foster Wheeler is driven by delivering value to our clients, providing safe and sustainable project solutions, developing the full potential of our people and contributing to the communities we work in.

Amec Foster Wheeler's Acoustics Centre of Expertise is located in Mississauga, Ontario, Canada, and supports the North and South American geographies in our various key markets. The concept of a Centre of Expertise is an exciting new and growing area for Amec Foster Wheeler. We rely on collaboration between multiple offices across the Americas and the globe to deliver quality driven work to our clients. The Acoustic Centre of Expertise was founded in 2013, and its key members, a core group of senior engineering practitioners, have a combined collective experience of over 50 years in acoustics, noise and vibration. We offer consultancy, engineering, and project management services in the core areas of environmental noise, transportation noise, building acoustics, monitoring of noise and vibration, including both assessment and mitigation of noise and vibration. We also collaborate with our other Amec Foster Wheeler acoustics practitioners in the UK.

2 Areas of Focus

We are experienced with environmental noise and vibration as they relate to industrial and manufacturing facilities, construction and blasting activities, renewable energy, and occupational health. We have also completed many transportation noise projects involving the impact on the acoustic environment from transportation sources including roads, aircraft, and rail. We bring our extensive expertise with transportation (e.g. All Aboard Florida High Speed Rail Project and various TTC Projects) and environmental (e.g. Pampa de Pongo Mining Project, Ontario Power Generation) concerns, an understanding of regulatory and policy requirements, and experience with handling community

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consultation for our environmental and transportation clients – both locally and across the Americas.

The successful design and operation of any building involves incorporating various engineering disciplines - including architectural, mechanical, electrical and structural. These disciplines continue to evolve in their need to address noise and vibration. We have extensive successful experience delivering building acoustic projects (e.g. UofT Innis Town Hall and Cinema Retrofit) by ensuring the integration of acoustics throughout the entire design, delivery and commissioning process.

We have the knowledge and experience to address vibration generating activities and associated impacts to buildings and structures (e.g. Deloro Mine Site Cleanup Project Blasting). Typical sources of vibration we address include construction equipment, rail transportation and explosive blasting.

The measurement and monitoring of noise and vibration is a requirement for a variety of projects and diverse jurisdictions. We are continually involved in the measurement of individual sources of noise and vibration, as well as monitoring construction for on-going noise and vibration impacts to communities (e.g. Edmonton Downtown Tunnel Construction Vibration) as well as long-term operational noise monitoring from facilities and transportation corridors.

3 Sample Projects

3.1 Rumble Strip Noise

Amec Foster Wheeler conducted a detailed assessment of rumble strip noise for the Ontario Ministry of Transportation. Noise levels (both interior and exterior to the car) were investigated and a classification of noise characteristics for the different designs was developed. From this investigation, we were able to identify various design characteristics (width, distance between strips, angled) that contributed to overall noise levels, and tonal components, of rumble strip designs.

Figure 1: Rumble strip noise testing

3.2 UofT Innis Town Hall and Cinema Retrofit

Amec Foster Wheeler was choosen to provide acoustic design for the retrofit of the University of Toronto Innis College Town Hall and Cinema. The Acoustic Centre of Expertise integrated with the project team from the early stages of conceptual and detailed design, tendering and construction. We were successful in meeting the interior reverberation time criteria for the cinema, while significantly upgrading the sound isolation to adjacent spaces in Innis College through wall and door construction upgrades.

Figure 2: University of Toronto Innis College Town Hall and Cinema

3.3 Edmonton Downtown Tunnel Construction Vibration

The Amec Foster Wheeler Acoustic Centre of Expertise, in collaboration with the local Edmonton office, has and is continuing to conduct vibration monitoring for the City of Edmonton's Downtown Intensification project. This involves standard vibration monitoring for drop shaft construction and tunnel boring activities, as well as specific vibration monitoring of Nuclear Magnetic Resonance (NMR) spectroscopy and experimental labs at the MacEwan University.

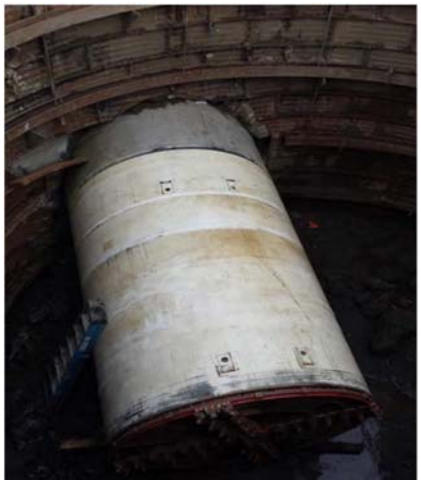

Figure 3: Tunnel boring machine breaking through receiving shaft

THE ACOUSTIC RESEARCH IN THE DEPARTMENT OF ARCHITECTURAL SCIENCE RYERSON UNIVERSITY

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Résumé

Le laboratoire de la science du bâtiment dans le département de sciences architecturales a les capacités pour mener des expériences d'évaluation des propriétés de matériaux acoustiques. Quatre tubes d'impédance sont disponibles pour évaluer le coefficient d'absorption et un certain nombre de propriétés associées. Les tests utilisant un système a deux microphones ainsi que les tests utilisant un système à trois microphones peuvent y être effectués. Un soufflerie à échelle réduite peut être utilisée pour des expériences de localisation de sources. Modélisation détaillée par éléments finis, en utilisant COMSOL, peut être utilisé pour prédire la performance acoustique des silencieux passifs, les résonateurs de Helmholtz ainsi que la propagation du son dans des souffleries. La simulations Aero-acoustiques est également possible en utilisant le puissant logiciel "ACTRAN". Enfin, la recherche acoustique reliée au auditorium et salle sont réalisées en utilisant à la fois les outils de simulation ainsi que des études expérimentales. Les détails de la recherche seront mis en évidence dans ce bref résumé.

Mots clefs : propriétés des matériaux, aéro-acoustique, conception de contrôle de bruit

Abstract

The building science laboratory in the Department of Architectural Science has capabilities to conduct research activities in the field of room acoustics and noise control. Four impedance tubes, with both two-microphone and three-microphone systems, are available to evaluate the absorption coefficient as well as a number of other material properties. A scale model wind tunnel is also available for source localization experiments. Detailed finite element modelling, through COMSOL, are used to predict acoustic performance of passive silencers, Helmholtz resonators as well as sound propagation in the available wind tunnels. Similarly, aero-acoustic simulations are also possible by using the software ACTRAN. Finally, auditorium and room acoustic researches are conducted through simulations as well as through in field measurements.

Keywords: Room acoustics, material properties, aero-acoustics, noise control design

1 Introduction

The Department of Architectural Science (DAS) at Ryerson University has two faculty members whose teaching and research focus on acoustics and noise control.

Two acoustics courses catered to architectural science students are being offered at the undergraduate level. The third year course teaches basic acoustic materials on room acoustics and sound transmission. The fourth year course (also available to graduate students) deals with acoustics of performance spaces.

The main areas of the acoustics research are described below.

2 Architectural Acoustics

Sound represents one of the most valid and often underestimated ways to experience a space. The acoustics of heritage buildings is often crucial. This new attention to cultural heritage has fostered the study of the relationship between the architecture and its acoustics. Within this context, the acoustics of Italian historical buildings (mainly churches [1, 2] but also theaters [3]) was researched by Dr. Berardi over the last decade. Similarly, the music rooms were researched through both simulations and site measurements by Ramakrishnan and Dumoulin [4]. Room acoustics studies have been performed using both detailed analysis as well as software simulations with EASE, CATT and/or ODEON.

3 Acoustic Materials

The characterization and testing of new building materials and building systems is among the most active area of research in the DAS Acoustic Lab at Ryerson. Sustainability principles and new design criteria provide the impetus to study new systems composed of natural materials (mainly vegetative fibers) for sound absorption treatments [5]. Based on their microscopic configurations, both porous absorbing cellular as well as fibrous materials have been considered (Fig.1). Sound absorption, air resistivity, open porosity, and tortuosity measurements have been conducted and the results

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were used to develop theoretical model to predict the behaviour of these materials. In addition, the acoustic behaviour of nanotechnologies, such as aerogel, in room acoustic applications, has been of recent interest. Four impedance tubes (Fig.2) are available in the laboratory and the research is continuing to determine the effect of compression on porous materials [6].

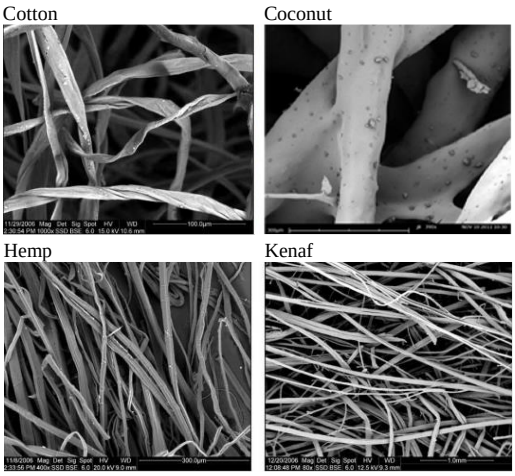
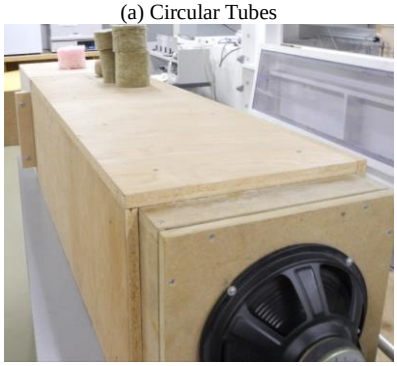


Figure 1: Materials studied for acoustic applications (from [5]).

(a) Circular Tubes



(b) Square Tube

Figure 2: Photos of the impedance tubes.

4 Aero-Acoustics

The acoustics lab has been gifted with a pilot wind tunnel (PWT) with a top speed of 250 kph. The PWT, shown in Figure 3, has been used to study the acoustical performance of wind tunnel components such as corner vanes and the use of Helmholz resonators to attenuate the very low-frequency circuit resonances. In addition, numerical calculations can be undertaken with the use of software such as COMSOL multiphysics and Actran. One such simulation study evaluated the acoustic performance of large corner vanes with varying treatments is reported in [7].

Figure 3: Photo of the pilot wind tunnel

5 Noise Control

Various aspects of noise control research have been conducted, such as the evaluation of the performance of elbow silencers [8]. Basic research in experimental methods of building acoustics is also a primary research area [9]. In addition, research is on-going in understanding wind turbine noise sources as well as realistic prediction methods [10].

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