**Project #1 Title: Low frequency sound insulation wall**

**Project Description (approximately 300 words)**

Project description: Soundproof wall design (Low-frequency band)

With the acceleration of urbanization, the problem of noise pollution is becoming more and more serious, especially in areas with heavy traffic and industrial areas. Noise not only affects the quality of life of residents, but may also have a negative impact on health. Therefore, it is of great practical significance to design an efficient sound insulation wall to reduce the impact of noise on the surrounding environment.

Specific challenges:

Multi-band noise control: noise sources are diverse and the frequency range is wide, and the design needs to consider the noise control of different frequencies.

Material selection: It is necessary to choose materials that are both effective and economical.

Structural design: To ensure the stability and durability of the sound insulation wall under different environmental conditions.

Technical requirements:

Material properties: Select efficient sound absorbing materials, such as sound absorbing cotton, rock wool, etc., to ensure the sound insulation effect at different frequencies.

Structural design: Design a reasonable wall structure to ensure the effective use of sound insulation materials and the stability of the wall.

Acoustic analysis: A detailed acoustic analysis is performed to evaluate the sound insulation of the design proposal and to optimize it.

Project objectives:

Reduce noise pollution: Design and build a sound wall that can effectively reduce noise pollution.

Improve the quality of life: improve the living environment and health of residents by reducing noise.

Economical and practical: under the premise of ensuring the sound insulation effect, the cost is controlled to ensure the economy of the project.

Expected deliverables:

Design scheme: detailed acoustic wall design drawing and construction scheme.

Material Selection Report: A detailed report on the selection of sound insulation materials, including performance test results.

Acoustic Analysis Report: A report that analyzes and evaluates the acoustic performance of a design proposal.

Construction of sound insulation wall: a section of sound insulation wall is built at the designated location and the actual effect is tested.

**Project Content Areas (please select all that apply)**

√ Mechanics/Mechanical Design  Heat Transfer/Thermodynamics  Fluid Mechanics

Controls/Instrumentation √ Materials Science

**Project Scope (please select all that apply – specify percentage of total project activity):**

√ Analytical Design (30%) √ Computer Aided Design (30%) √ Simulation (10)

Programming/Coding (%)  Prototyping/Fabrication (%) √ Experimental Validation (30%)

Other: Please Specify with activity %

**Is this a sponsored project?**

Yes √ No

If **YES**, please specify the sponsor: Name of Project Sponsor

**Is this project part of a larger group project involving multiple capstone design groups?**

Yes √ No

If **YES**, please specify the team numbers of your collaborating teams and list your respective project scopes: Team Numbers and Scope

**Project Logistics**

1. Are the tools (physical and software) available to students for work on this project?

√ Yes  No

1. Is there space identified for students to work on this project?

Yes √ No

If **YES**, please specify the location of this space:

Location of workspace allocated to students

1. Is there a budget associated with the completion of the project?

Yes √ No

If **YES**, please specify the budget: $ Approximate project budget

1. Are there any non-student technical advisors identified to help guide this project?

√ Yes  No

If **YES**, please specify the names of these advisors:

Dr. Qi Li

Have you already received consent from these advisors to help guide this project?

√ Yes  No

1. Is there an external deadline for the completion of the project deliverable?

Yes √ No

If **YES**, please specify the external deadline:

Project Deliverable Deadline

**Project #2 Title: Mid-band sound insulation wall**

**Project Description (approximately 300 words)**

Medium frequency noise, 800~2500Hz, 1500Hz increase 2dB, sound forward, human voice, drum forward, hardness feeling increased. Provides a sense of sound hardness, power, and distance. Lean forward very firmly. This project is about how to achieve real life mid-band noise reduction through structure. There are a lot of mid-band noise in life, and in places where there are a lot of voices, noise reduction through the structure can be achieved. In life, many commercial study rooms, bookstores and so on need a quiet place. Noise reduction through this structure can help these places achieve noise isolation. I hope to achieve noise reduction based on the damping restraint plate vibration reduction structure. Plate structure is widely used in aerospace, rail transit, ships, automobiles and many other fields. At the same time, such structure is also an important radiation source and transmission path of noise in the cabin of modern carrier equipment, which significantly affects the vibration and noise level in the cabin. Therefore, it is of great significance to study the vibration and noise suppression methods of the plate structure for improving the vibration and acoustic environment in the carrying equipment compartment. Surface addition damping is a common method for vibration and noise reduction of plate structures, and the related research is still widely concerned. Traditional damping treatment methods mainly include free damping treatment and constrained damping treatment, in which the traditional constrained damping treatment is to cover the whole or large area of the damping material on the surface of the matrix structure, and then attach a restraint layer on it. This method uses the shear deformation of the damping layer to consume vibration energy, which can effectively reduce the vibration and noise of the structure in the middle and high frequency, but the vibration and noise reduction effect in the low frequency band is not ideal, and is not conducive to the realization of the lightweight design of the structure. Therefore, the optimization of damping vibration and noise reduction effect and the lightweight design of damping structure have become an important direction of research on damping vibration and noise reduction technology, and many domestic and foreign scholars have carried out relevant research.

**Project Content Areas (please select all that apply)**

√ Mechanics/Mechanical Design  Heat Transfer/Thermodynamics  Fluid Mechanics

Controls/Instrumentation √ Materials Science

**Project Scope (please select all that apply – specify percentage of total project activity):**

√ Analytical Design (30%) √ Computer Aided Design (30%) √ Simulation (10)

Programming/Coding (%)  Prototyping/Fabrication (%) √ Experimental Validation (30%)

Other: Please Specify with activity %

**Is this a sponsored project?**

Yes √ No

If **YES**, please specify the sponsor: Name of Project Sponsor

**Is this project part of a larger group project involving multiple capstone design groups?**

Yes √ No

If **YES**, please specify the team numbers of your collaborating teams and list your respective project scopes: Team Numbers and Scope

**Project Logistics**

1. Are the tools (physical and software) available to students for work on this project?

√ Yes  No

1. Is there space identified for students to work on this project?

Yes √ No

If **YES**, please specify the location of this space:

Location of workspace allocated to students

1. Is there a budget associated with the completion of the project?

Yes √ No

If **YES**, please specify the budget: $ Approximate project budget

1. Are there any non-student technical advisors identified to help guide this project?

√ Yes  No

If **YES**, please specify the names of these advisors:

Dr. Qi Li

Have you already received consent from these advisors to help guide this project?

√ Yes  No

1. Is there an external deadline for the completion of the project deliverable?

Yes √ No

If **YES**, please specify the external deadline:

Project Deliverable Deadline

**Project #3 Title: High frequency sound insulation wall**

**Project Description (approximately 300 words)**

The high frequency of sound is between 5000-8000Hz, and the extremely high frequency is usually between 8000-12000Hz (or 14000HZ). Normally, a sound of 4000Hz can be heard by people, but this sound has a negative impact on human hearing, causing irreversible effects and even leading to hearing loss in severe cases. During the construction process, high-frequency sounds may sometimes be emitted, so our team will search for materials and structures that can reduce the impact of high-frequency sounds on the human ear and apply them in practice.

**Project Content Areas (please select all that apply)**

√ Mechanics/Mechanical Design  Heat Transfer/Thermodynamics  Fluid Mechanics

Controls/Instrumentation √ Materials Science

**Project Scope (please select all that apply – specify percentage of total project activity):**

√ Analytical Design (30%) √ Computer Aided Design (30%) √ Simulation (10)

Programming/Coding (%)  Prototyping/Fabrication (%) √ Experimental Validation (30%)

Other: Please Specify with activity %

**Is this a sponsored project?**

Yes √ No

If **YES**, please specify the sponsor: Name of Project Sponsor

**Is this project part of a larger group project involving multiple capstone design groups?**

Yes √ No

If **YES**, please specify the team numbers of your collaborating teams and list your respective project scopes: Team Numbers and Scope

**Project Logistics**

1. Are the tools (physical and software) available to students for work on this project?

√ Yes  No

1. Is there space identified for students to work on this project?

Yes √ No

If **YES**, please specify the location of this space:

Location of workspace allocated to students

1. Is there a budget associated with the completion of the project?

Yes √ No

If **YES**, please specify the budget: $ Approximate project budget

1. Are there any non-student technical advisors identified to help guide this project?

√ Yes  No

If **YES**, please specify the names of these advisors:

Dr. Qi Li

Have you already received consent from these advisors to help guide this project?

√ Yes  No

1. Is there an external deadline for the completion of the project deliverable?

Yes √ No

If **YES**, please specify the external deadline:

Project Deliverable Deadline