

# **WATERLOO** **ENGINEERING**

**Senior Team Design  
Competition Problem**

Spring 2010  
Waterloo Engineering Competition  
July 9-10

**GENERAL RULES**

1. All questions regarding the competition problem must be asked during the welcome and briefing session. No questions will be answered during the design and build stage.
2. Teams are not allowed to leave the DWE building unless they have submitted their prototype and presentation to competition staff.
3. All communication devices must be turned off throughout the duration of the competition.
4. Wireless on laptops must be turned off. Violation of this rule will result in immediate disqualification.
5. Visitors are not allowed throughout the design and build stage. Violation of this rule will result in immediate disqualification.
6. Teams may only use materials they have purchased in the shop.
7. Final prototype and presentation materials must be submitted to the submission desk prior to the end of the design and build stage. It is the team's responsibility to bring its deliverables from the design area to the submission desk.
8. Competitors may not use the blackboard when delivering presentations.
9. Keep work spaces clean. Tidy up at the end.

**SCHEDULE**

The schedule of the Senior Team Design competition is as follows:

Friday, July 9	5:45 p.m. – 6:00 p.m.	Sign-In	DWE 2527
	6:00 p.m. – 6:30 p.m.	Welcome/Briefing	DWE 2527
	6:30 p.m. – 12:30 a.m.	Design/Build	Various Assigned Classrooms
Saturday, July 10	8:45 a.m. – 9:00 a.m.	Sign-In	RCH 301
	9:00 a.m. – 12:30 p.m.	Presentation/Demonstration	RCH 301

Volunteers will give instructions to teams on when and where to get their pizza, which will be available at some time between 9:00p.m. - 10:00p.m. Please remind the competition coordinators and volunteers of your dietary restrictions and/or allergies.

Dress code for presentation and demonstration is business casual.

There will be a question period after the problem is presented. No questions will be answered during the development and build stage to ensure fairness in the competition.

**THEME**

The theme of the Spring 2010 Senior Team Design is an avalanche rescue mission.

**SCENARIO**

Avalanches pose a serious risk for sport enthusiasts and mountain dwellers alike. While they are predictable to a certain degree, catastrophic situations often arise that leave humans buried or stranded with a limited window of time for rescue. In order for a helicopter rescue mission to be possible, the weather must often be ideal, which does not always coincide with the circumstances of an avalanche. The owners of a back country hotel in the Rockies would like to provide their guests with reliable emergency services in the event of an unexpected avalanche.

The rescue vehicle must be able to travel across the snowy terrain without difficulty, but more importantly, locate victims buried under the snow and debris. The skiers and hikers are required to carry magnetic transponders to identify their location in case of such an event. The slope of the terrain can be a significant obstacle for normal snow vehicles as well, so in order to reduce the danger to the rescue team, an unmanned option needs to be developed for use in all weather conditions.

**OBJECTIVE, REQUIREMENTS & CONSTRAINTS**

Design a rescue vehicle remotely controlled through minimum two (2) metres of cable using only the materials provided. It must be able to navigate the given terrain in the above scenario and retrieve victims from four avalanche locations on the mountain. The locations vary in grade and depth of snow. The vehicle must not exceed 20 cm x 20 cm x 17 cm (L x W x H) in dimension, and should be able to locate and rescue victims without overly disrupting the pockets of snow surrounding the victims (since that might cause a cave in). If the vehicle needs to enter the unstable area surrounding the victim, points will be deducted for increasing risk.

The remote control and the attached cable must not have direct physical impact on the rescue vehicle, i.e. steering by pulling the vehicle is not allowed. Only one person is allowed to operate on the remote control at any time; another person can hold up the cable to prevent physical interference. Teams are not permitted to touch the vehicle during demonstration. The cost of the design prototype may not exceed \$8,500.

**PROTOTYPE TESTING RULES**

A portion of the terrain will be available for teams to perform prototype testing. Each testing period is 10 minutes, and is signed-up for on a first-come-first-serve basis.

**Reservations**

Each team may only have one reservation at any time, and must use up the testing period before reserving the next one. Teams may only reserve whichever time slot is available next (i.e. teams may not specify a time).

**Cancellations**

Teams are allowed to make cancellations to reservations. A cancelled time slot then becomes the next available testing period, and can be reserved by whichever team makes the reservation next. Time slots after the cancellation will not be bumped up.

**Consumable Items**

Some items are consumable, for example: batteries. Teams are responsible for purchasing enough of these consumable items from the shop during the design and build phase to successfully complete the presentation and demonstration.

**SHOP RULES**

1. A maximum of two (2) people per team may be in the shop at any time.
2. All sales are final. Be sure to verify purchased items and quantities before leaving the shop.
3. Teams may not trade building materials. Violation of this rule will result in immediate disqualification for both teams.
4. The competition shop will keep track of the official expense forms. However, teams are encouraged to keep track of their own Purchase Requisition Form to have an idea of how much they have spent. The shop will not tell teams how much they have already spent.
5. The shop will close 30 minutes before the development and build stage ends.

**DELIVERABLES**

At the end of the six- (6) hour development and build stage, each team is required to submit the following items:

1. A working prototype of the machine
2. A PowerPoint presentation
3. Purchase Requisition Form (both sheets)

**MARKING SCHEME**

The following marking scheme is specific to the Spring 2010 Senior Team Design competition and will be used by judges during presentation and demonstration.

<b>Design &amp; Performance</b>	<b>60%</b>
Retrieve Magnet from Hole #1	8%
Retrieve Magnet from Hole #2	8%
Retrieve Magnet from Hole #3	12%
Retrieve Magnet from Hole #4	12%
Retrieve Magnet from Hole #5	20%
Finish early	+ 5% per minute*
Not able to move at all†	- 60%
Get stuck in terrain (an needs re-adjustment)	- 10% each time*
<b>Presentation</b>	<b>25%</b>
Design Process	6%
Meet Constraints & Criteria	6%
Quality & Flow	6%
Highlights & Usability	5%
Prototype Critique	2%
Cost below \$2500	+ 10%*
Cost over \$8500	- 40%*
<b>Originality</b>	<b>10%</b>
Daring/Outside the Box	4%
Creativity	3%
Uniqueness	3%
<b>Teamwork</b>	<b>5%</b>
Knowledge	2%
Workload Distribution	2%

Compatibility	1%
Positivity	+ 1%*
Follow Dress Code	+ 1%*
<b>TOTAL</b>	<b>100%</b>

In case of a tie in total marks, the teams will be ranked based on their points scored in Design & Performance.

Completed marking sheets will not be disclosed to competitors; however, if teams wish to know their strengths and weaknesses for improvement in future competitions, judges will be available after the competition for questions.

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\* The  $\pm$  signs denote bonus or penalty points, respectively. Lowest possible score for each marking category is zero (0) points.

† The WEC marking scheme explicitly states that a vehicle not being able to move constitutes as a design fail. Be sure to keep this in mind when competing at the OEC, as the same rule applies but is not stated in the marking scheme.

**PURCHASE REQUISITION FORM**

Team Number: \_\_\_\_\_  
Team Member #1: \_\_\_\_\_  
Team Member #2: \_\_\_\_\_  
Team Member #3: \_\_\_\_\_  
Team Member #4: \_\_\_\_\_

<b>Item</b>	<b>Unit Price</b>	<b>Quantity</b>	<b>Total Price</b>	<b>Volunteer Initial</b>



**PURCHASE REQUISITION FORM (continued)**

Team Number: \_\_\_\_\_

Team Member #1: \_\_\_\_\_

Team Member #2: \_\_\_\_\_

Team Member #3: \_\_\_\_\_

Team Member #4: \_\_\_\_\_

Item	Unit Price	Quantity	Total Price	Volunteer Initial