

# **WATERLOO** **ENGINEERING**

**Senior Team Design  
Competition Problem**

Fall 2010  
Waterloo Engineering Competition  
November 5-6

**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, Nov 5	5:45 p.m. – 6:00 p.m.	Sign-In	DWE 3522
	6:00 p.m. – 6:30 p.m.	Welcome/Briefing	DWE 3522
	6:30 p.m. – 12:30 a.m.	Design/Build	Various Assigned Classrooms
Saturday, Nov 6	8:15 a.m. – 8:30 a.m.	Sign-In	RCH 3 <sup>rd</sup> floor lobby
	8:30 a.m. – 9:30 a.m.	Presentation/Demonstration	RCH 307
	9:30 am – 9:45 am.	Prizes and Winner Announcements	RCH 307

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 Fall 2010 Senior Team Design is Ancient Engineering.

### **SCENARIO**

We have always held a great fascination for the marvels of ancient engineering. From the pyramids to the Taj Mahal, the ingenuity of the engineers before us has long fascinated generations to come. Your problem today is to act as mercenary engineers. A king needs you to design a vehicle to conduct a search and rescue operation around his castle. Bobbin Good has been stealing gold from the King. The King's men have located multiple storage facilities where Bobbin keeps the gold he steals before redistributing it among the townspeople. Your assignment is to design a vehicle that will collect gold from each of these facilities and return it to the castle.

The rescue vehicle must be able to travel across the terrain without difficulty, but more importantly, locate and collect gold scattered around the castle. Additionally, upon arrival at the castle, the vehicle will be required to cross the moat by bridge. The bridge, from years of war, has become slightly dysfunctional. The vehicle entering the castle must be strong enough to climb the drawbridge and make its way across and into the castle through the heavy doors.

### **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 gold from **all four** storage locations in the forest. The vehicle must not exceed 20 cm x 20 cm x 15 cm (L x W x H) in dimension, and should be able to collect as much gold as possible. In addition the vehicle must be strong enough to climb the drawbridge and enter the swinging door into the castle, completing the assignment by depositing the gold within the castle. Points are awarded to the number of storage facilities visited, whether the bridge was scaled and the number of locations from where gold pieces were retrieved.

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 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 that should last between 7 and 10 minutes
3. Purchase Requisition Form (both sheets)

Expect to have 5 minutes for setup and another 10 minutes for demonstration of your prototype. Judges may ask you questions during this interval.

**MARKING SCHEME**

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

<b>Design &amp; Performance</b>	<b>60%</b>
Collects gold from region #1	5%
Collects gold from region #2	10%
Collects gold from region #3	15%
Collects gold from region #4	20%
Prototype crosses door and deposits gold in the castle	10%
Finish early	+ 5% per minute*
Not able to move at all†	- 60%
Get stuck in terrain (or fall off platform)	- 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.







**MATERIAL LIST****Electrical Items**

Motor -Small	\$850
Motor -Large	\$1,500
ON/OFF/ON toggle switch	\$150
Battery holder 4-AA cells	\$20
Battery holder 8-AA cells	\$35
AA Battery	\$17
Stranded wire 22 AWG	\$3/10cm
Solder	Free
Electrical Tape	\$8/cm

**Miscellaneous**

Rattrap	\$200
Foam board (custom size)	\$11/cm <sup>2</sup>
Wooden board (15 cm x 15 cm)	\$800
Wooden board (custom size)	\$7/cm <sup>2</sup>
Popsicle stick	\$60
Nail	\$20
Toothpick	\$4
Styrofoam Ball (Medium)	\$100
Plastic straw	\$50
Steel wire 20 AWG (no insulation)	\$4/cm
Rope	\$10/cm
Cotton twine	\$3/cm
Plastic spoon	\$50
Plastic plate	\$280
Styrofoam cup	\$300
Pot pie pan	\$350
Muffin cup	\$20
Aluminum foil	\$20/cm
Sand paper	\$50/cm
Medium zip tie (15 cm x 0.4 cm)	\$60
Small zip tie (10 cm x 0.3 cm)	\$40

Elastic band	\$40
1/4" Dowel	\$15/cm
7/16" Dowel	\$20/cm
3/16" Dowel	\$30/cm
3/8" Dowel	\$30/cm
1/2" Dowel	\$40/cm
3/2" X 2" Square Stick	\$40/cm
Rat trap	\$1,300
Duct tape	\$8/cm
Super glue	\$80
Paper Muffin Cup	20
Hot glue stick	\$50
Paint Roller (Large)	\$400
Paint Roller (Small)	\$250
Wood (6" x 6")	\$600
Sponge	\$200
Double Sided Tape	\$15/cm
Plastic Fork	\$50
Clothes Pin	\$100
Masking tape	\$7/cm
Felt Protectors	\$100/each
Skewer	\$20/each