

WATERLOO **ENGINEERING**

**Junior Team Design
Competition Problem**

Spring 2011
Waterloo Engineering Competition
July 8-9

SCHEDULE

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

Friday, July 8	5:30 p.m. – 5:45 p.m.	Competitor Check-In	RCH 211
	5:45 p.m. – 6:30 p.m.	Welcome/Briefing	RCH 211
	6:30 p.m. – 10:30 p.m.	Design/Build	Various Classrooms
	10:30 p.m. – 11:00 p.m.	Submissions/Debriefing	RCH 211
Saturday, July 9	7:00 a.m. – 7:30 a.m.	Competitor Check In	RCH 3rd floor lobby
	7:15 a.m. – 7:20 a.m.	Judges Check In	
	7:20 a.m. - 7:30 a.m.	Judges Briefing	RCH 305
	7:30 a.m. – 10:50 a.m.	First round of Presentations	RCH 301, 302
	10:50 a.m. - 11:05 a.m.	Deliberation and break for judges	RCH 301
	11:05 a.m. - 11:10 a.m.	Announcement of finalists	RCH 302
	11:10 a.m. - 12:30 p.m.	Second round of presentations	RCH 301
	12:30 p.m. - 12:40 p.m.	Final Deliberation	RCH 301
	12:40 p.m. - 1:00 p.m.	Announcement of winners	RCH 302

Pizza will be available to teams around 8:00p.m. – 8:30p.m., during the design and build stage. Please remind the competition coordinators and volunteers of your dietary restrictions and/or allergies.

GENERAL RULES

1. Competitors will be presented with a 15 minute question period following the welcome and briefing. Competitors may ask as many questions as they like during this period. However, after this, questions about the problem statement will not be answered.
2. All communication devices must be turned off throughout the duration of the competition.
3. Visitors are not allowed throughout the design and build stage. Violation of this rule will result in immediate disqualification.
4. Dress code for presentation and demonstration is business casual to business formal.
5. Competitors may not use the blackboard when delivering presentations.
6. All submitted materials must be labelled according to the following guidelines:
 - a. Prototypes must have the team number clearly labelled.
 - b. The team number and names of all team members must be written on the back of the poster.
7. If teams are unsure about rules or require further clarification, please ask one of the organisers. Volunteers may be able to assist, but in the event of discrepancies between volunteers and organisers, the organisers' opinion will be followed.
8. Time remaining in the competition will be announced to competitors at the 2 hour, 1 hour, 30 minute and 10 minute marks.
9. Keep work spaces clean. Tidy up at the end.

THEME

The theme of the Junior Team Design competition is “Disaster Relief”.

SCENARIO

Major earthquakes, like the one that occurred in Japan, occur all around the world. They cause collateral damage to people and infrastructure. One concern is destruction of land which results in broken, un-traversable roads. In emergency situations this can impede or halt direly needed rescue operations.

OBJECTIVE, REQUIREMENTS & CONSTRAINTS

Your engineering company has been approached with a contract to provide a solution. You must design and prototype an emergency self-deploying road in order to allow vehicles to traverse broken road.

The road must span a distance of 50 cm, and must be 10 cm wide when expanded. The release mechanism must be one-touch (ie hit a button, flick a switch, release a pin, etc). This mechanism must be deployable in a minimum amount of time after the one-touch event. Points will be awarded for creative set-up mechanisms and design. The top surface of the road (on which a vehicle would drive) must be made out of the specified road pieces (light-weight wood). Teams will be given five (5) 10 x 10 cm blocks. Extra road pieces will be available for purchase from the store along with the rest of the materials. The exterior of each piece may not be modified (ie block cut in half or edges modified). However, the interior can be modified (ie. Drill holes) but must still be traversable.

These road laying contraptions must be small and lightweight to allow for easy transportation to and from the location, as well as allow for easy storage when not in use. Before deployment, the entire contraption must be smaller than 25 x 25 x 15 cm (this includes the road laying mechanism and the road itself).

You will have a 4 hour time limit from the beginning of the build session to create a working prototype and a poster board for presentation. Entries that are received late will be disqualified. Prototypes and posters are due in the shop at the end of the build session. Each team has a budget of \$2000. Cost-effectiveness is an important objective.

After the build session, the teams will be required to present their solution to a panel of judges. You will use the poster board aide to present as a team to the judges. Following this, you will have a total of 3 testing tries to complete the challenge. Points will be awarded for a cost-effective solution. Be prepared to be held accountable for all money spent.

DELIVERABLES

At the end of the development and build stage, each team is required to submit the following items:

1. A working prototype of the machine
2. A poster presentation as a visual aid

PROCEDURAL RULES

The following rules must be followed during the design and build stages of the competition. Any teams in violation of these rules may be disqualified at the discretion of the WEC staff.

1. Teams have four (4) hours to complete the design and construction of their prototypes.
2. Teams are not allowed to leave the competition premises unless they have submitted their prototypes and presentations to the competition staff.
3. Laptops are not permitted.
4. Teams may only use materials that they purchase from the shop. Teams may not return or trade purchased materials.
5. Provided tools may only be used to construct the prototype and may not be used as part of the prototype. The tools must be returned at the end of the design and build phase of the competition.
6. 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.
7. Teams will receive a notification when there is one (1) hour remaining in the design and build phase.
8. Purchase Requisition Forms at the shop are to be completed by WEC staff only.

PROTOTYPE TESTING RULES

In the first 20 minutes of the design and build stage, the scenario setup is open to all teams to look at and take measurements. Afterwards, the scenario setup 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. There will be two setups available.

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.

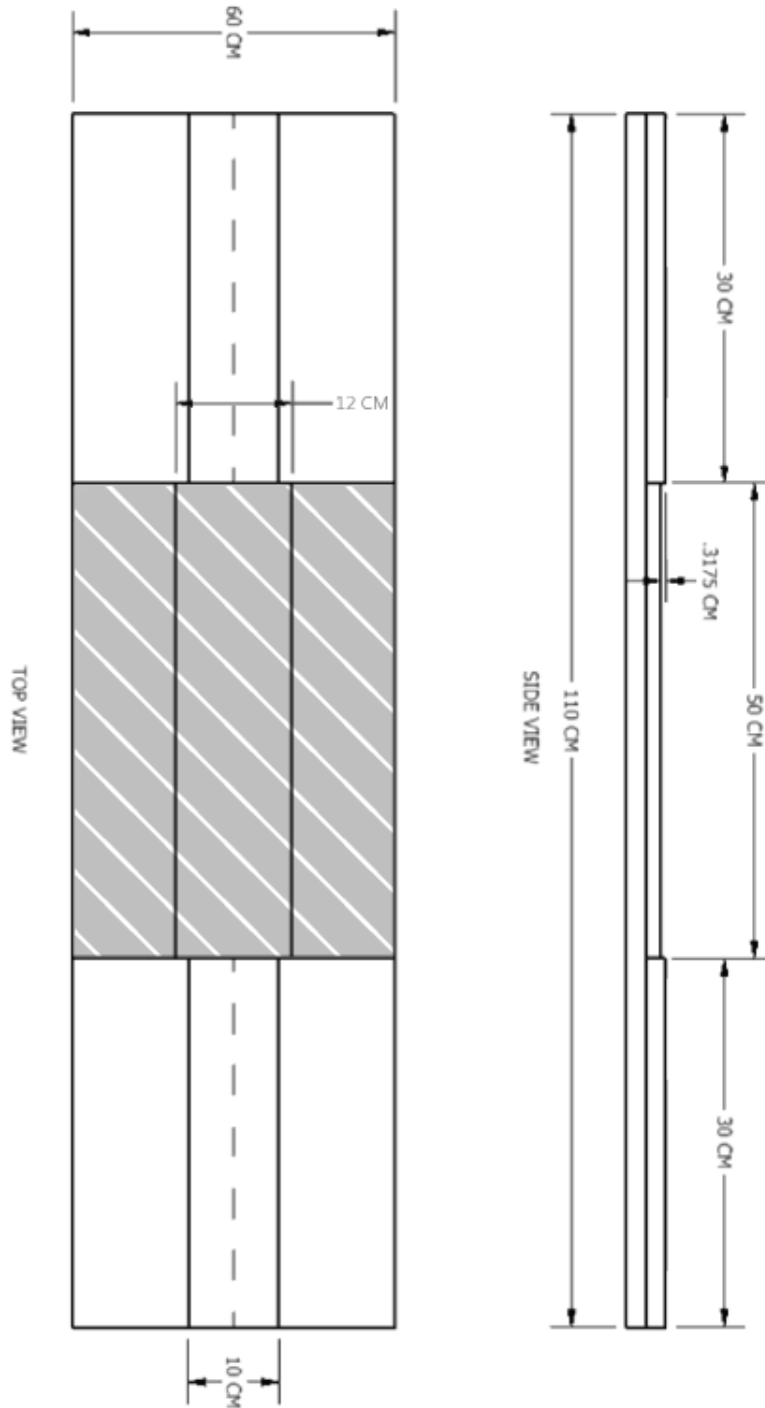
PRESENTATIONS

Teams will create and present a 6-8 minute presentation for a panel of judges. Order of the presentation and the rooms in which teams present will be determined randomly, and will be announced 30 minutes prior to the presentation start time. Parts of the presentation should be shared equally between the team members. Testing of the prototype will be given a maximum amount of time of 5 minutes and will follow the presentation.

Judges will be then permitted 5 minutes following the presentation in which judges and the general audience may ask questions.

Because of numbers, teams will be divided into two rooms with two judge panels for initial judging. The top two teams in each room will perform a second presentation to all judges. From here, the judges will select the winning teams. The first place team will represent the University of Waterloo at the Ontario Engineering Competition in February 2012 at the University of Toronto. In the event that the first place team is unable to attend, the second place team shall take their place.

TEST SCENARIO MEASUREMENTS



Note: Drawing is not to scale. Centre portion of track is cracked and broken, and shown cracks are not an accurate representation. The first 20 minutes of the design and build stage can be used to view the actual test setup.

SHOP RULES

1. A maximum of one (1) person per team may be in the shop at any time.
2. Building materials will be available for preview at the shop. Competitors may examine the materials, but are not allowed to leave the display table with unpaid materials.
3. Teams are allowed to take pictures of building materials with a camera, but not a cell phone.
4. Teams must purchase the quantity of items that they request. If a requested quantity is not available, the team may request a new quantity.
5. Teams must keep track of their purchases for their own records. The shop will keep track of the official purchase records. In the event that a team has lost track of their purchases, the team will not be told how much they have spent.
6. All sales are final. Be sure to verify purchased items and quantities before leaving the shop.
7. Teams may not trade building materials. Violation of this rule will result in immediate disqualification for both teams.
8. Please be courteous and professional to shop personnel. The shop reserves the right to refuse service to an individual who behaves unprofessionally.

MATERIALS LIST

Material	Unit Price (\$)
Foam Sheets **	100
Foam Board (per cm ²)	2
Cardboard (per cm ²)	2
Wood (20 x 10 cm section) **	600
Paper Plates	50
Pot Pie Pans	100
Dump Truck Scoop	100
Mouse Traps	300
Rat Traps **	800
Tensile Springs (assorted sizes) **	120
Elastics (assorted sizes)	50
Skewers	80
Dowels (2 sizes)	Small – 100 Big – 120
Popsicle Sticks (2 sizes)	Small – 20 Big – 40
Toothpicks	10
Plastic Spoon	20
Plastic Fork	20
Plastic Knife	20
Straws	30
Paper Clips (2 sizes)	Small – 10 Big – 20
Thumb Tacks	50

Binder Clips (2 sizes)	Small – 80 Big – 100
Nails (assorted sizes)	50
Eye hooks (assorted sizes)	60
Clothes Pins	60
Wheels (2 wheels => free axel)	150
Styrofoam Cups	70
Styrofoam Balls (2 sizes)	Small – 80 Big – 100
Zip Ties	70
Steel Wire (per cm)	5
Twine (per cm)	4
String (per cm)	2
Pipe cleaners	40
Felt (per cm ²) **	1
Magnets **	75
Playdoh (per g)	3
Sponges	60
Balloons	30
Duct Tape (per cm)	10
Masking Tape (per cm)	3
Double Sided Tape (per cm) **	10
Hot Glue Sticks	60
Extra Road Pieces	200

Note: ** denotes a rare item

MARKING SCHEME

The following marking scheme is specific to the Spring 2011 Junior Team Design competition and will be used by judges during presentation and demonstration.

Design & Performance	50%
Drivable distance (6% per section)	30%
Precision (2% per section)	10%
Average deployment time per section	10%
Does not fit inside box	-5%
Prototype does not move	- 50%†
Does not start behind the line	- 30%*
Prototype damages test setup	- 20%*
Presentation	35%
Poster	10%
Quality & Flow	7%
Design Process	5%
Meet Constraints & Criteria	5%
Highlights & Usability	5%
Prototype Critique	3%
Cost: every 10% under budget (up to max 5%)	+ 1%*
Cost: every 10% over budget	- 2%*
Creativity / Originality	10%
Teamwork	5%
Workload distribution	3%
Team synergy	2%
Does not follow dress code	- 2%*
Workroom not tidied up	- 2%*
TOTAL	100%

DESIGN AND PERFORMANCE DEFINITIONS:

Deployed Road: A road section is considered deployed if it lies completely in the cracked section of the test setup and does not overlap above any other road sections. A deployed road section is allowed to overlap above other materials purchased from the shop, but the top of the section cannot be more than $3/8^{\text{th}}$ of an inch above the test setup's cracked surface.

Driveable Road: A road section is considered driveable if it meets the criteria of being deployed and the widest gap between it and the previous road section is less than $3/8^{\text{th}}$ of an inch (this will be measured by seeing if a dowel $3/8^{\text{th}}$ of an inch in diameter fits between the sections). Additionally, half of the road section must line up with the previous road section to be for it to be considered driveable (dotted line can line up with the edge of a piece). For the first piece, the road on the starting platform counts as the previous road section.

DESIGN AND PERFORMANCE CRITERIA EXPLAINED

Driveable distance – The number of driveable road sections successfully deployed.

Precision – The number of deployed road sections successfully laid between the green guide lines. The section must be completely inside the guide lines (not touching the line at all) to be considered successful.

Deployment time per section – Points will be awarded on a per section basis, according to the following equation:

$$x = \left\lceil 10 - 5 \left(\frac{t}{n} \right) \right\rceil; \quad x \geq 0$$

Where x is number of points received, t is total deployment time in seconds and n is number of deployed sections.

NOTE:

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, the judging comment sheet will be provided.

* 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 contraption 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: _____

Item	Unit Price	Quantity	Total Price	Volunteer Initial

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