

WEIR-WARMAN AND ENGINEERS AUSTRALIA DESIGN & BUILD COMPETITION - 2005

Project “SCAD” – Safe Collection and Delivery

Following recent tremors and quakes on the planet Gondwana, concern has been expressed about effective rescue of citizens caught on the wrong side of large crevices. It is proposed that a device be designed and trialled to transport passengers from the significantly at-risk hillside communities along the “Superior Fault-Line” to the safer more stable plain below.

In the “ACME Pinnacle Laboratory”, the Gondwanan Land Rescue Organisation is struggling to arrive at a design that might be feasible. Fortunately, teams of engineering students from Earth are about to visit Gondwana as part of their work experience programmes. On previous visits engineering students have rendered invaluable assistance, and the Gondwanans again seek help from these budding engineers.

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Objective

The objective is to design, build and prove a prototype device in a laboratory environment that serves to transport safely citizens across a substantial crevice, to a significantly safer plain below. Can you assist in Project SCAD – the **Safe Collection And Delivery** of Gondwanan citizens?

See below for:

- Competition Rules
- Frequently Asked Questions
- Further Competition Details

Document History:

Version 1 Released 16 February, 2005

Version 1.1 Released 30 August, 2005

NO RULE CHANGES

Photos of ADFA Track (to be used at Final – practice and/or competition)

Broad arrangements for National Final

Competition Rules

Original Released: 16/02/2005

ELIGIBILITY

1. Teams of up to four, nominally second-year mechanical-engineering students in Australian or New Zealand universities (or other universities by arrangement), may enter the competition. Teams of three or four are recommended.

SAFETY

2. Safety is of paramount importance when participating in this competition. All engineers should know that injury and damage to equipment and the environment occurs when the control of energy in a system is lost.

3. Students should submit a risk assessment for their device to their campus organizer prior to campus testing. Students should be encouraged to embrace risk management and may need to demonstrate and produce risk assessment documentation at the Final.

4. Safety glasses or full face masks should be worn by all students working on devices at all times, during construction, during testing, and during competitions.

5. Devices that are deemed by the judges to be hazardous will not be permitted to run.

6. Devices which damage the competition site are prohibited.

MATERIALS AND MANUFACTURE

7. Students should manufacture their prototype device themselves using commonly available materials, components and methods.

TRACK

8. The competition site modelling a “road” with a hypothetically “transverse very deep crevice” shall consist primarily of two sheets of Medium Density Fibreboard (MDF) of nominal dimensions 2400 x 1200 x 19 mm placed end to end (see Figure 1) but separated by a 400 mm horizontal gap. The road segments also join with two 600 x 1200 x 19 mm horizontal “starting” and “finishing” platforms which are horizontal extensions of the road.

9. The profile of the road, as shown in Figure 1, models a gentle hill descending from a plateau with two distinct gradients (approximately -10% and -5% assuming standard 2400 length sheets) leading to a valley floor. The highest point of the track is to be set at a height of 0.36 m (the “starting platform”) above the “finishing platform”. The intermediate change in road gradient and the edges of the crevice occurs at a height of 0.12 m above the finishing platform. Transversely, the road is horizontal (having no camber).

[Organisers please note that track segments from the 2004 competition could be reused with “starting” and “finishing” platforms added. Organisers may choose to rig a net or some additional barriers around the crevice to help with the containment of “lost” golf balls. Devices should not contact any items so rigged and the items should not encroach upon the track.]

10. On the first road segment (i.e., 10% grade), two rows of 9 holes to support stepped plastic golf tees vertically will be aligned 250 mm either side of the road centreline at 200 mm longitudinal spacings beginning 400 mm from the top edge. The holes of 5.5 mm diameter shall be drilled to a depth of 12 mm. The golf tees used shall be (or be similar to) “Elim” nylon stepped golf tees as shown in Figure 2. To protect the track against possible damage from tees being punched through the road segment, it is recommended that a backing strip be attached under the line of the holes.

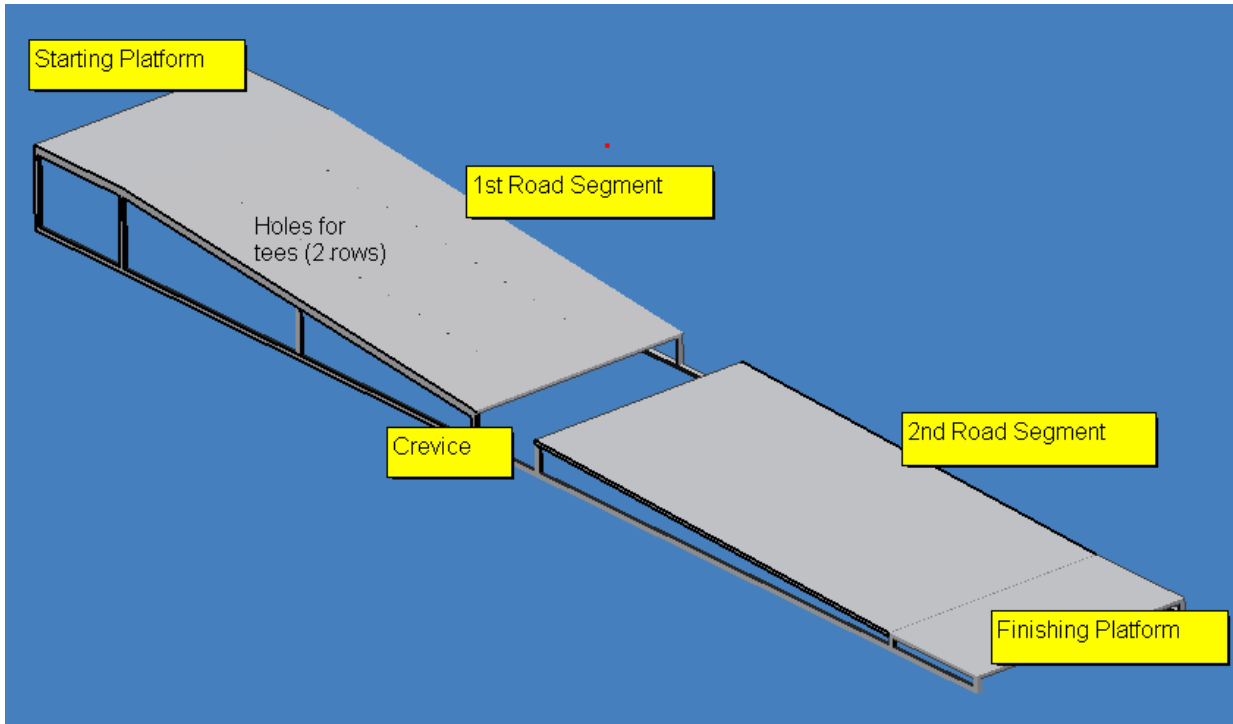


FIGURE 1 - PROJECT "SCAD" COMPETITION TRACK CONCEPT



FIGURE 2 - ELIM NYLON GOLF TEES

11. Ten golf balls will be randomly positioned on ten tees leaving eight positions clear. The balls represent the passengers to be rescued. The height of support above the road offered by the tees will vary in the range of 15 to 45 mm. A minimum of three balls will be positioned in a given row.

12. The finishing platform shall be framed on its free three sides with nominally 12 x 12 DAR timber strips to provide a "rest". This frame will be mounted by nails or screws on the top surface of the finishing platform with its outside edges flush with the MDF sheet.

13. All surfaces of the MDF sheets will be brush coated with one coat of Watty Estapol Speed Clear followed by two coats of Watty Instant Estapol Matt.

OBJECTIVE

14. The aim of the project is to collect and deliver the “passengers” (golf balls) from their starting positions (on the golf tees) to the “finishing platform”. Points are awarded for both safe collection and safe delivery.

PROCEDURE

15. The “net mass” of the device, will be measured in kilograms (with an accuracy of 10 grams).

16. When the track is clear, the ten golf balls will be positioned on 10 tees that have been cut to various lengths. The placement will be in a pattern as directed by the “chief official” for the particular run.

17. The pattern will be defined by pairing a tee with a hole position number based on the sequential drawing of a tee from a bag and a numbered card from a shuffled deck of 18 cards. If a drawn card would indicate that an eighth ball is added to a row, that card will be set aside and another card drawn. Setting out the balls on the tees will be done quickly with a Team member and official just prior to the team’s setup time commencing.

18. Having viewed the ball placement, and at the direction of an official, the Team will be allowed a maximum of three minutes to set up their device on the competition site. Contact by Team members or the device with any track surface other than the starting platform during setup is prohibited. The Team will indicate to the appropriate official when their setup is complete.

19. Prior to running and after set up, the device must be wholly contained within a 400 mm cubic envelope which has two faces parallel with the starting platform surface and one of these faces in the plane of the starting platform. The device at this time must be stationary and in plan view, must not project beyond the edges of the starting platform. These conditions may be physically checked by an official.

20. On instruction and by a signal from the “official starter”, the run will commence. The device will be started using a single action that does not impart motion or energy to the device.

21. After performing the single action start, Team members shall not control or touch the device in any way until directed by officials after the end of the run. Any interference by Team members will result in a zero score for the run. If team members choose to intervene to protect a device that is malfunctioning, a zero score for the run will be recorded.

22. The run must be completed within 60 seconds. Runs exceeding 60 seconds will result in a zero score for the run being recorded.

23. During the run the device must not come into contact with anything other than the top surface of the MDF sheets modelling the starting platform, the two segments of the road and the finishing platform; the near vertical edges of the sheets modelling the crevice; the finishing platform rests, the golf tees and the golf balls.

24. The crevice is to be imagined to be very deep but nothing should touch the actual floor or other supporting structure in way of the crevice. Touching the floor with any item other than a golf ball (lost passenger) or dislodged golf tee will attract a zero score for the run. Parts of the device may “enter” the crevice, but the actual depth of the crevice as modelled will depend on how the specific competition site is constructed. The depth available in which to work should not be assumed to be more than 140 mm.

25. At the completion of the run and within the maximum allowable run time, the overall device and passengers if released in this time must become and remain stationary indefinitely

relative to the road. Mechanisms within the overall static boundaries of the device (as defined by line-of-sight) may continue to move.

26. The Team shall indicate to the timekeepers when they declare their run to be complete. However, the time keepers will make the final judgment as to when the device becomes stationary and the recorded time may exceed the declaration.

27. All golf balls shall be returned to the designated official at the completion of each run.

SCORING

28. The “passengers” should be safely transferred from their starting positions to the finishing platform. Better devices will achieve the evolution safely, will implement it at a reasonable speed and will have higher transportation efficiency (interpreted as a lower net device mass).

29. The run scores are based on the following formula:

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AScore = (number of "passengers" safely picked up + (2 * number
of "passengers" safely delivered to "finishing
platform")) * "time factor"
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Where "time factor" = 2.0 for run time < 10 sec
1.5 for 10 sec < run time < 20 sec
1.0 for 20 sec < run time < 60 sec
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Bscore = net mass of device
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30. Each team may attempt two runs and the Weir-Warman Competition Score will be the best score achieved from either run. The highest Weir-Warman Competition AScore wins. The device may be modified between runs.

31. For a passenger to be considered to have been picked up safely, at the end of the run they shall be constrained by the device without violating any rule or have been released from the device and reside on the finishing platform.

32. For passengers to be considered to have been safely delivered to the finishing platform at the end of the run, they shall have wholly passed through the vertical plane of the leading edge of the finishing platform, and be on the finishing platform or constrained by the device over the finishing platform. If constrained by the device, some pathway is to be established between the passengers' location and the finishing platform to represent a disembarkation route (ie. some contact must be made with the finishing platform).

33. Passengers left on their original support (on a tee) or “lost” (defined by their contacting the floor) will not be considered to have been safely picked up or safely delivered.

34. Devices that damage the “passenger supports” (golf tees) will be given a zero run score. However, dislodging a tee from the hole in which it was originally placed without plastic deformation does not constitute damage.

35. If equal AScores are recorded, teams will be ranked in their AScore groups based on their BScore with lower BScores preferred.

36. In the case of a tie for first place based on AScores, those teams with BScores that are within 1.10 times the minimum BScore of the set of teams in the tie shall participate in a sudden death run-off to define the overall placings.

37. In the event of a run-off, each team will make a run attempting the safe collection and delivery of 10 passengers. If equal AScores are again recorded, the number of potential passengers will be incremented by 2 in successive rounds until only one team prevails with a superior AScore. If ultimately more than one team successfully delivers 18 balls to the finishing platform, the team with the shortest run time in the last round will be declared the winner. If in a given round of the run-off, all teams record a zero AScore, the team with the shortest run time in the previous round will be declared the winner.

38. If additional runs are required, teams will be asked to rerun with a minimum five-minute interval.

39. The judges' decisions on all matters pertaining to the competition will be final.

40. Campus organisers are free to modify the rules and or track for their local competition but the rules as stated will be strictly adhered to at the Weir-Warman Final. A document outlining some possible considerations will be separately distributed to campus organisers.

Frequently Asked Questions

(Last Updated: 30/8/2005)

1. Does the device have to stay in contact with the MDF at all times?

No but the rules do define what can be legally contacted. See rule 21.

2. Please provide some details of a constructed track.

The following photos are of the track fabricated for the UNSW@ADFA campus competition.



FIGURE FAQ 2 - UNSW@ADFA Track

Further Competition Details

(Last Updated: 30/8/2005)

NATIONAL FINAL

The Weir-Warman National Final will be held Friday 23rd - Sunday 25th September 2005 in Sydney at the Powerhouse Museum (PHM). The format will have students gathering for an initial welcome at the PHM on Friday morning (11.15 AM). Students should be able to gain access to the PHM and their "pit" area from 9 AM and are asked to be present at the PHM by 11 AM at the latest. A tour of Weir Warman Ltd will follow on Friday afternoon. An initial competition briefing will be held on Friday afternoon after the Warman tour. The PHM closes at 5 PM. Scrutineering will be conducted on Saturday morning and there will be briefings, presentations and practice sessions held on Saturday. The actual running of the final and the National Finals Dinner will be on Sunday.

A team registration form is available on the competition web site – submit to Nina Lenz of Engineers Australia: NLenz@engineersaustralia.org.au, Ph 02 6270 6548, Fax 02 6273 2358, Mob 0409 304 447. Team details are required by no later than Wed 31st August (unless otherwise advised).

Travel arrangements are coordinated by Nina Lenz. Students and Campus Organisers attending will be booked to arrive in Sydney on Friday 23rd September (morning) and to return home on Monday 26th September also in the morning. For some students and Campus Organisers, due to home locations, they will be flown into Sydney on Thursday 22nd September, arriving early evening. It is essential that any students and Campus Organisers that wish to arrive and depart from Sydney at any specific times or who wish to extend their stays in Sydney notify Nina prior to Monday 5th September otherwise flight times will be decided by the travel agent based on the Competition program and available flights.

In meeting costs, the competition sponsorship funds two students per team. Campus Organisers are also being funded this year. Campuses will be billed for additional students and for people who do not travel but for whom arrangements are made.

SPIRIT OF THE COMPETITION

The rules look rigid because we have tried to be very clear on the important points. Engineering reality is rarely so specific. It is essential to work with your campus organiser from an early stage, and for the campus organiser to verify decisions with the National Organiser so that everyone has the same understanding of the meaning of the rules. If you think you see a loophole, clear it with your campus organiser before you rely on it in competition. Even if you get away with it at local level, you might be in for a shock at the national level where the interpretation might be different. Provision will be made for confidentiality, so your idea will not be passed on to other students.

The competition site will be made with reasonable care but because it is a real engineering object it may well be "wrong" in various small ways. For example the planes of the slope might not be exactly at the specified angle, or might have a slight transverse slope. Your team is expected to consider these possibilities in your design, and develop a device that can function even if the competition site has slight imperfections. In other words, you are not allowed to blame failure of your device on some minor imperfection with the competition site.

A FINAL COMMENT ON SAFETY

Please be aware that in 2003 during a campus competition, a student was lucky to escape serious eye injury when a device went off unexpectedly. While Campus organisers run their own competitions independently, they are strongly encouraged to consider all aspects of safety in relation to the conduct of their competition.