

DESIGN CHALLENGE PROJECT SPECIFICATION AND RULES.

Institution of
**MECHANICAL
ENGINEERS**

EXTERNAL PIPE CLIMBER PROJECT - 2019



External Pipe Climbing Device

Undergraduate Design Challenge 2019

*Note:- This Specification must be read in conjunction with the
General Specification*

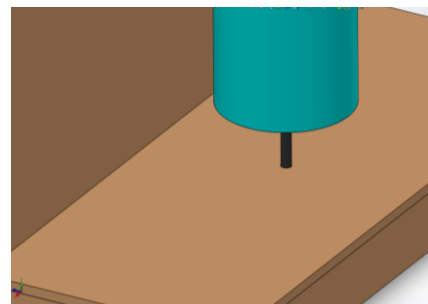
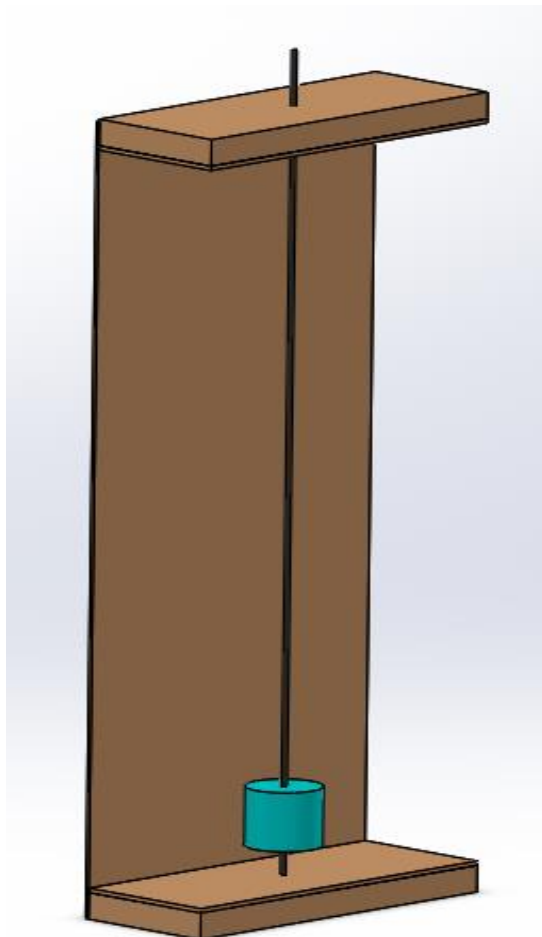
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1. Introduction

This year the challenge is to design, build and test a device to climb up the outside of a piece of 15 mm copper pipe lifting an increasing load in the form of a chain. At the top the device will reverse and return to its original starting point. The 'device' can be of any construction but it must be electrically powered and meets the size and cost specification detailed below. The relative performance will be determined on the quickest time taken for the device to pull the load to the top of the tube and return to the starting point at the bottom.

The rig will comprise of the pipes located into 17mm diameter holes. These will allow the pipe to be lifted upwards if required so that the device can be fitted onto the pipe. The pipe will then be replaced before the commencement of a run. An illustration is below with the chain removed for clarity. Figure 1 dimensions the external pipe climber test rig



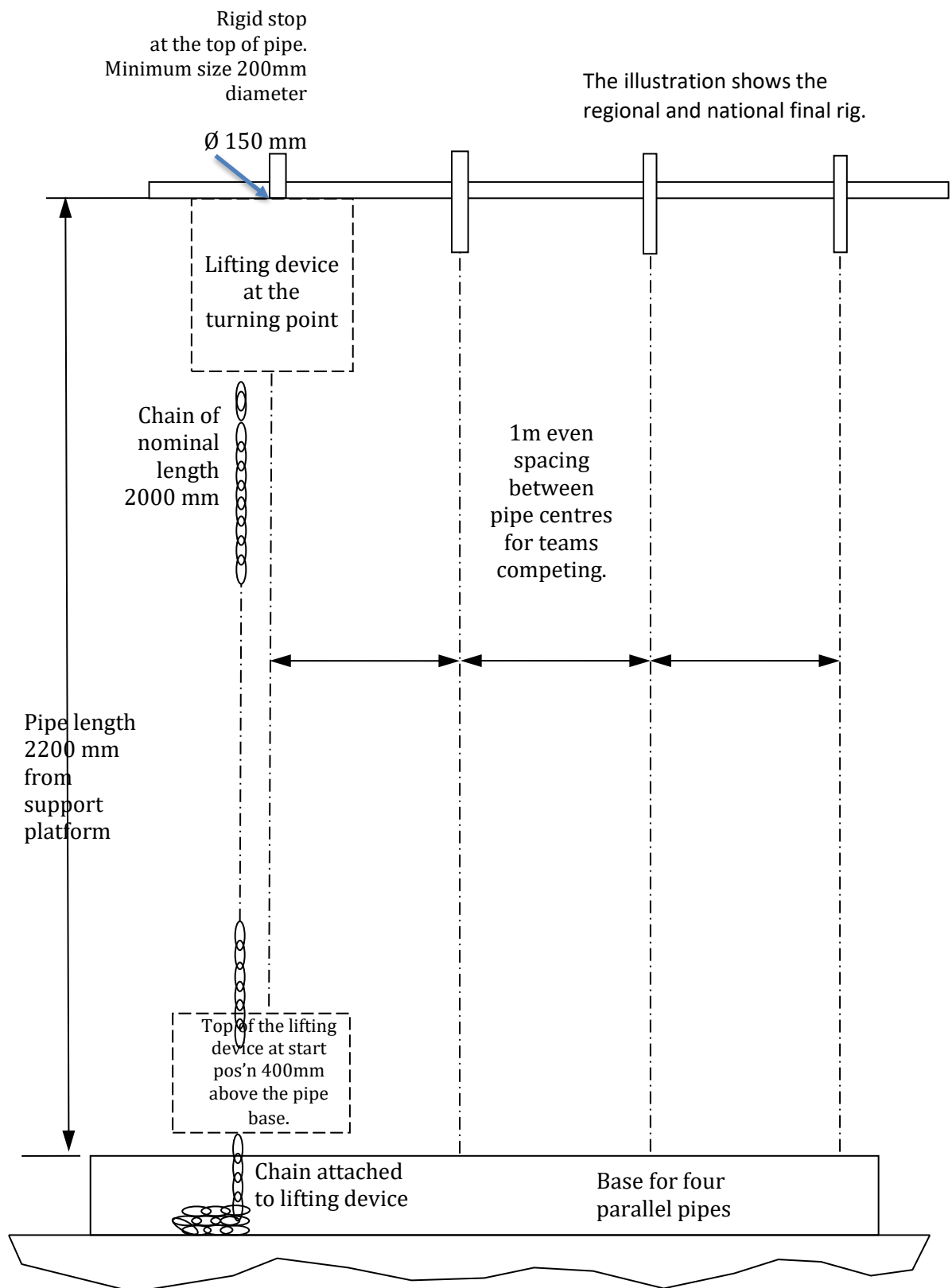


Figure 1. Schematic of Design Challenge equipment

2. Rules

2.1. The 'device' can be of any type, but it must be self-contained and at all times during the competition fit within a cylindrical envelope of 200 mm radius and 300 mm height, as shown in Figure 2 below. On the day of the competition this will be checked using a gauge.

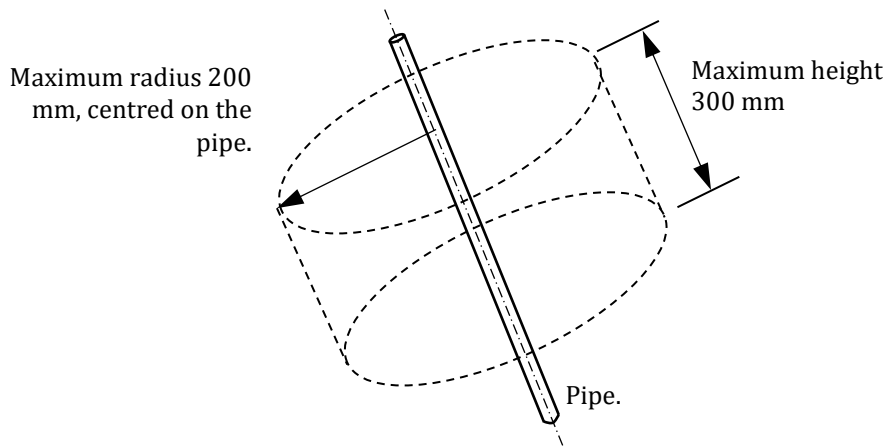


Figure 2. Space envelope for the lifting device.

2.2. The test area will consist of up to four identical pipes to allow for parallel runs. The "Device Controller" is allowed to hold their device in position up to or below the datum line (0.4m above bottom of the pipe) before starting. The teams competing in a heat will be required to start their devices simultaneously. Once started there can be no outside interference. Having started their device the Device Controller must then step away from the tube.

2.3. The devices must have a method of attachment/detachment to a length of chain. Failure of the attachment or loss of the chain will result in disqualification from the heat.

2.4. The parts list must be clearly displayed by all teams during static judging and scrutineering. Teams will be expected to justify the purchase cost of any item detailed on or off the parts list. All devices must be 'signed off' by the academic staff member of the individual universities to say that their student's device meets all of the scrutinising rules concerning cost, specification and safety, before the final competition. On the day of the competition after successfully completing the scrutinising process teams will be given a sticker, this must be attached to the device

as proof of conformity. Any team that enters a heat without this sticker will not be allowed to compete.

2.5. Once a heat has started the device may not be touched until it is over. The device may not be caught and if required, impact protection should be designed as part of the device.

2.6. No adhesive or lubricant is to be used between the device and the tube. Devices must not cause any damage or leave any debris on the external surfaces of the tube.

2.7. Heats will consist of up to four devices running in parallel. Each team should attempt all three heats. The time will be recorded for each successful attempt. The time is measured from the "Starters Order" until the top of the device passes the datum in the downward direction. The device must make contact with the top after the upward travel and before the downward travel.

2.8. The top four teams (or top three teams if there are less than four tubes on the competition rig) in the heats returning the quickest time and meeting the specification requirements will progress to the final. A record of performance of each group will be recorded using the table shown in Appendix A.

2.9. In the event if a tiebreaker at the end of the heats or for a place in the final or in the final there will be a rerun of one single attempt and if there is a further tie the lightest device will be the winner.

2.10. In the unlikely event of there being no clear winner on reaching the time limit, or there is a technical fault to test apparatus (not devices) deemed to unfairly disadvantage a team, there will be a rerun. For any tie after a rerun then the lightest device will be designated the winner.

2.11. The time limit for the heats and final will be two minutes. Time will start from the end of the timekeepers starting countdown.

2.12. Heat one will run with the first group of teams and then the second group and so on. This will allow some time for adjustments between the heats.

2.13. It is permissible to replenish the device's energy source between testing. Competitors should consider this during their design process so as to minimise disruption to the smooth running of the event. Any team not ready to compete within three minutes of being called will be disqualified.

2.14. If a device fails to operate and the team have completed at least one run the time will be used as their quickest time recorded provided they attempt to compete in all other heats.

2.15. The total cost of the device must be under £25. The cost of any batteries must be included as part of the design even if they are under 20p.

2.16. Details of the pipe and chain suppliers including part references can found at the following links:-

<https://www.screwfix.com/p/wednesbury-copper-pipe-15mm-x-3m/98683>

http://www.diy.com/departments/side-welded-steel-chain-3mm-x-2m/1267464_BQ.prd?icamp=recs&rrec=true

Please note that the above suppliers are not mandated. These references are included only for those Universities that are unable to purchase these items from existing approved suppliers.

3. APPENDIX A

Record of Performance Template

	Time (Secs)				
GROUP	HEAT 1	HEAT 2	HEAT 3	QUICKEST TIME FROM THE THREE HEATS	RANKING
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					

FINAL	FINAL TIME	RANKING
TBC		
TBC		
TBC		

4. List of Changes

Date	Version	Changes
09 July 2018	1.0	Release of Specification