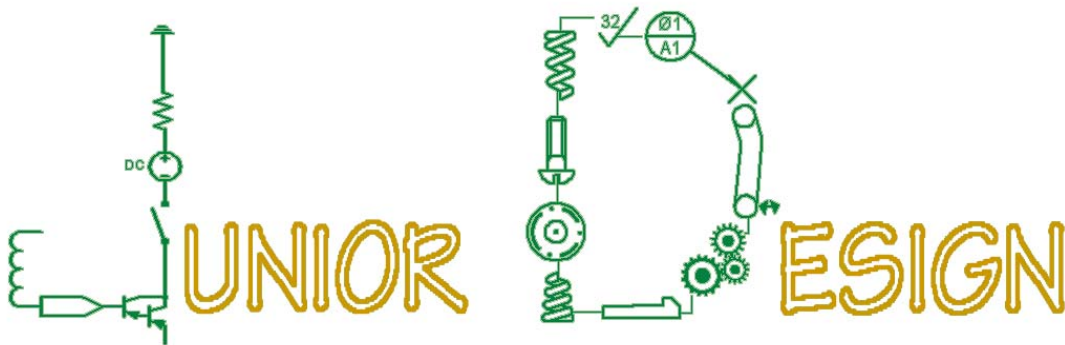
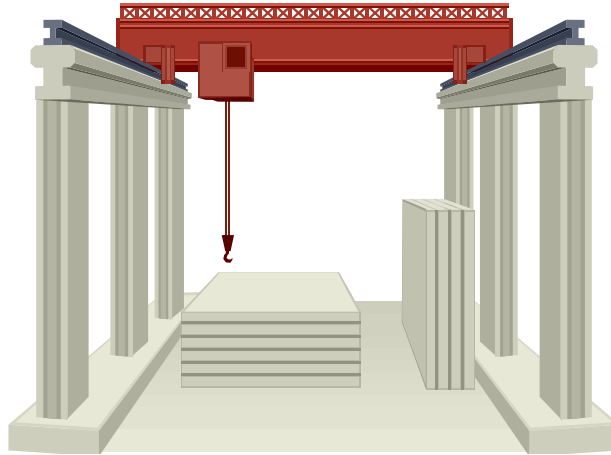


REQUEST FOR PROPOSAL
FOR ENGINEERING DESIGN

GANTRY GAMES

Automated Material Placement



EGR 3380
Engineering Design I
FALL 2010

Department of Electrical and Computer Engineering
Department of Mechanical Engineering
BAYLOR UNIVERSITY

1. STATEMENT OF WORK

Qualified engineering design teams are invited to submit technical proposals for the design of an *Automated Material Placement Device*, hereinafter referred to as *AMP*. Proposals are to be submitted to the instructors of EGR 3380, hereinafter referred to as the *client*. Upon client approval of a conceptual design, each engineering design team, hereinafter referred to as the *team*, shall build, test, and evaluate a prototype device, and shall provide the client with full engineering documentation of the prototype design.

Additional instructions and schedules not included in this RFP for completing design, presentation, construction, testing, and documentation milestones will be found in the course calendar, milestone assignment documents, and other specific documents to be distributed by the client at appropriate times during the project. The design, construction, testing, and reporting of the AMP is a requirement for completion of Engineering 3380 - Engineering Design I at Baylor University for the Fall Semester 2010.

2. DESIGN SPECIFICATION

2.2 Background

One of the most common types of machinery is materials-handling machinery. From conveyor belts to cranes, all manner of devices are designed to pick up, place, move, or sort materials and parts. Some of these devices are manually controlled; others perform their tasks automatically. The project described in this RFP calls for the design of an automated materials placement device in the form of a gantry.

A gantry is a materials transporting device that moves horizontally along an overhead rail (with either one or two directions of motion). Typically a gantry consists of the rail(s), the mechanism(s) to move laterally along the rail(s), and a hoist to lift and lower materials. A two-direction gantry is illustrated schematically on the cover of this RFP.

2.3 Design Requirements

2.3.1 General function:

The general objective of the AMP device is to autonomously move along a 1-D rail and deposit three marbles in three separate receptacles located beneath the rail.

The process will begin with the AMP in a start position at one end of the rail. The team will then initiate the AMP with a single electrical switching action. The AMP will then move along the rail, depositing marbles in the specified receptacles. After depositing the last marble, the AMP will return to the start position and terminate its operation.

The longitudinal locations of the three receptacles will be variable. This means the AMP must determine the receptacle locations, which may be different for each operation.

GANTRY GAMES: The AMPs designed by different teams will be testing in the form a head-to-head competition. Two AMPs will simultaneously move along parallel rails and deposit marbles in similarly placed receptacles. The teams will be scored on the speed and accuracy of marble placement, along with overall time to complete operation.

2.3.2 Test Stand:

The client will provide a test stand upon which AMPs will be tested. The test stand is detailed in drawings that are appended to this document. Briefly, the test stand is 48-in long by 24-in wide, with 20-in high vertical walls on both ends of the long direction. The stand can be thought of as having two 12-in wide by 48-in long playing fields side-by-side.

The tops of the walls will have two 1.5-in x 1.5-in slots, each halfway between the center and either edge. These slots are for mounting the AMP rails for the opposing teams. The bottoms of the slots will be approximately 20-in off the surface of the base.

Attached to the base, and running along a line parallel to the line between the centers of the slots, is a fixture to which the receptacles are mounted. The fixture will allow the horizontal locations of the receptacles to be varied. The tops of the receptacles will be approximately 10-in above the surface of the base. The receptacles are 1 X 3/4 CPVC couplings mounted on top of a length of 3/4-in CPVC pipe. This makes the openings in the tops of the receptacles cylinders with OD = 1.375-in (nom) and ID = 1.125-in (nom).

The receptacles (centers) may be located horizontally anywhere between 12-in from the starting wall to 10-in from the opposite wall. The closest possible spacing between receptacles (centers) is 2-in.

2.3.3 Marbles:

The marbles are nominally 9/16-in diameter glass (0.5625 ± 0.025).

2.3.4 Rail:

The team must provide its own rail. The design of the rail is at the team's discretion within the following constraints. The rail must mount into a pair of mounting slots at the top of the walls at either end of a client-provided test stand. The slots are 1.5-in X 1.5-in square. No part of the rail must be wider than the slots or extend below the plane defined by the bottom of the slots.

2.3.5 Power:

Power for the AMP device shall be supplied from a DC power source with a nominal voltage of 18 V. The source may either be dry cell batteries or an AC-to-DC power adapter (via a tether). In the case that an adapter is used, a maximum current of 2A is allowed, as specified by the adapter. In the case that dry cell batteries are used, these must be housed in the mobile portion of the gantry device.

2.3.6 Control:

After the AMP is mounted on the rail and in the starting position, it shall be activated by a single electrical switching action. After activation, the device shall operate autonomously under the control of an onboard microcontroller. The programming of the microcontroller shall guide the action and shall terminate the action of the AMP. No human intervention is allowed once operation begins.

2.3.7 Setup, Operation, & Reset:

When the team is called upon to test their device, they will have three minutes to secure their rail and AMP to the test stand and ready it for operation. After operation, the team will have another two minutes to switch the rail and AMP to the opposite side of the test stand and ready for repeat operation. Before, during, and after operation, no portion of the AMP may protrude into the opponent's side of the test stand, nor may it interfere in any other way with the operation of the opponent's AMP.

2.3.8 Safety:

The device must be deemed safe by the client. This includes, but is not limited to, to the following considerations with respect to the operator and others nearby: safety from electrical shock hazards; safety from pinch points; safety from sharp edges and points; safety from flying debris; safety from chemical contaminants. The device shall also operate without damaging the test stand, the opponent's device, or any part of the room.

2.3.9 Scoring:

The team will be awarded a score according to the following formula:

$$\text{Score} = (\text{PM} * 25 + \text{CO} * 5) + (\text{FM} * 5) = \text{Base} + \text{Bonus}$$

where,

PM = # correctly placed marbles (can be 0, 1, 2, or 3)

FM = # marbles placed first in a receptacle before opponent's (can be 0, 1, 2, or 3)

CO = Completed Operation factor. This is awarded if the device moves completely out of the starting area, releases all three marbles after leaving starting area, returns into the starting area after releasing marbles, and then terminates operation.

CO = 5 if operation time ≤ 15 s

CO = 4 if operation time ≤ 30 s, > 15 s

CO = 3 if operation time ≤ 40 s, > 30 s

CO = 2 if operation time ≤ 50 s, > 40 s

CO = 1 if operation time ≤ 60 s, > 50 s

CO = 0 if operation time > 60 s

By this formula, a team whose AMP correctly places all three marbles and completes its operation in under 15-s will receive a base score of 100. For each marble a team's AMP places in a given receptacle before the opposing team's AMP, the team will receive an additional 5 bonus points, for a total maximum score of 115. If two teams are judged to deposit marbles simultaneously, each will receive the bonus.

3. **SAFETY REQUIREMENTS**

The team shall conduct all construction and testing with safety as the paramount consideration. Failure to observe workplace safety rules will lead to penalties in performance evaluation. Egregious or repeated safety violations, or disregard for Safety Officers, can result in dismissal from the course.

Cleanliness in the workplace is expected at all times and in all work areas. Failure to observe workplace rules will lead to penalties in performance evaluation. The design team shall clean all work areas with each use.

4. REPORTING & DOCUMENTATION REQUIREMENTS

The team shall document the design by use of manuscripts, calculations, schematics, flowcharts, computer code, and design models/drawings. Specifications for required documentation and due dates not otherwise contained herein will be contained in the course calendar and/or will be distributed by the client at appropriate points during the project.

1.1 PRELIMINARY CONCEPTUAL DESIGN REVIEW (PCDR)

4.4.1 Date

9/23/2010

4.4.2 Objective

The PCDR is a formal presentation. The client should be apprised of your conceptual design progress; i.e., you should describe one or more solution concepts that your team is considering. The main goal is to foster constructive discussion of possible design approaches for the purpose of advancing the team toward concept selection.

4.4.3 Format

- Duration: 5-8 Minutes
- Given by one team member.
- Visual aids using PowerPoint and/or Elmo
- Business casual dress.

4.5 CONCEPTUAL DESIGN REVIEW (CDR)

4.5.1 Date

9/30/2010

4.5.2 Objective

The CDR is a *top-down* formal presentation to the client of the selected design concept. The client should understand how your proposed design will meet the specifications in this RFP. The client should gain a clear picture of the major components/systems and their overall arrangement/function. Furthermore, the client should understand your team's implementation plan for completing the project.

4.5.3 Format

- Duration: 7-10 Minutes
- Given by two team members, with approximately equivalent contributions.
- Professional quality visual aids (PowerPoint as primary platform); other visual aids as appropriate
- Business casual dress.

4.6 PRELIMINARY DESIGN REVIEW 1 (PDR 1) & DRAWING SET 1 (DS 1)

4.6.1 Date

10/7/2010

4.6.2 Objective

PDR 1 & DS 1 is for the purpose of communicating the detailed design of a major *subsystem* through a presentation and drawings.

4.6.3 Presentation Format

- Duration: 4-6 Minutes
- Given by one team member
- Professional quality visual aids (PowerPoint as primary platform); other visual aids as appropriate
- Business casual dress

4.6.4 Drawing Format

- Subsystem Drawings
 - Assembly drawing(s) of subsystem including *bill(s) of materials*.
 - Circuit schematic(s) for subsystem.
 - Detailed drawings of subsystem parts that must be manufactured

4.7 SUBSYSTEM TEST (SST)

4.7.1 Date

10/14/2010

4.7.2 Objective

The subsystem test is a hardware demonstration of the performance of the subsystem described in the PDR 1 & DS 1.

4.8 PDR 2 & DS 2

4.8.1 Date

10/21/2010

4.8.2 Objective

PDR 2 is for the purpose of communicating the detailed design and integration of two major *subsystems* through a presentation and drawings.

4.8.3 Presentation Format

- Duration: 4-6 Minutes
- Given by one team member
- Professional quality visual aids (PowerPoint as primary platform); other visual aids as appropriate
- Business casual dress

4.8.4 Drawing Format

- Subsystem Drawings
 - Assembly drawing(s) of all subsystems involved, including *bill(s) of materials* (and including revisions of DS 1).
 - Circuit schematic(s) for subsystems.
 - Detailed drawings of subsystem parts that must be manufactured

4.9 SYSTEM INTEGRATION TEST (SIT)

4.9.1 Date

10/28/2010

4.9.2 Objective

The system integration test is a hardware demonstration of the integrated performance of the two subsystem described in the PDR 2 & DS 2.

4.10 PDR 3 & DS 3

4.10.1 Date

11/4/2010

4.10.2 Objective

PDR 3 is for the purpose of communicating the detailed design of the entire device through a presentation and drawings.

4.10.3 Presentation Format

- Duration: 5-8 Minutes
- Given by one team member
- Professional quality visual aids (PowerPoint as primary platform); other visual aids as appropriate
- Business casual dress

4.10.4 Drawing Format

- System Drawings
 - Assembly drawing(s) of entire system and all subsystems including *bill(s) of materials*.
 - Circuit schematic(s) for entire system.
 - Detailed drawings of parts that must be manufactured

4.11 PRELIMINARY SYSTEM TEST (PST)

4.11.1 Date

11/11/2010

4.11.2 Objective

The preliminary system test is a preliminary hardware demonstration of the performance of the entire system as described in the PDR 3 & DS 3.

4.12 COMPLIANCE TEST (CT)

4.12.1 Date

11/18/2010

4.12.2 Objective

The compliance test is the final and critical hardware evaluation. System performance will be evaluated against all specifications. Data will be collected and analyzed.

4.13 FINAL DESIGN REVIEW (FDR)

4.13.1 Date

11/22/2010

4.13.2 Objective

The FDR is a public presentation of the design to a general audience including the client, other design teams, invited faculty, students, and guests.

4.13.3 Presentation Format

- Duration: 3 minutes \pm 20 seconds
- Given by one team member
- Professional quality visual aids (PowerPoint as primary platform); other visual aids as appropriate
- Professional dress

4.14 Final Report and Final Drawing Set (FR&FDS)

4.14.1 Date

12/6/2010

4.14.2 Objective

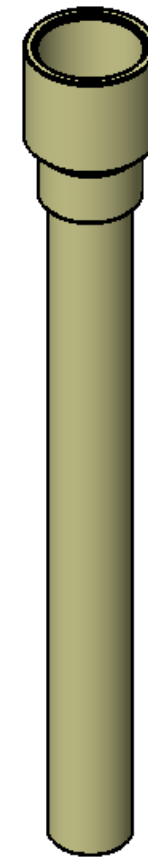
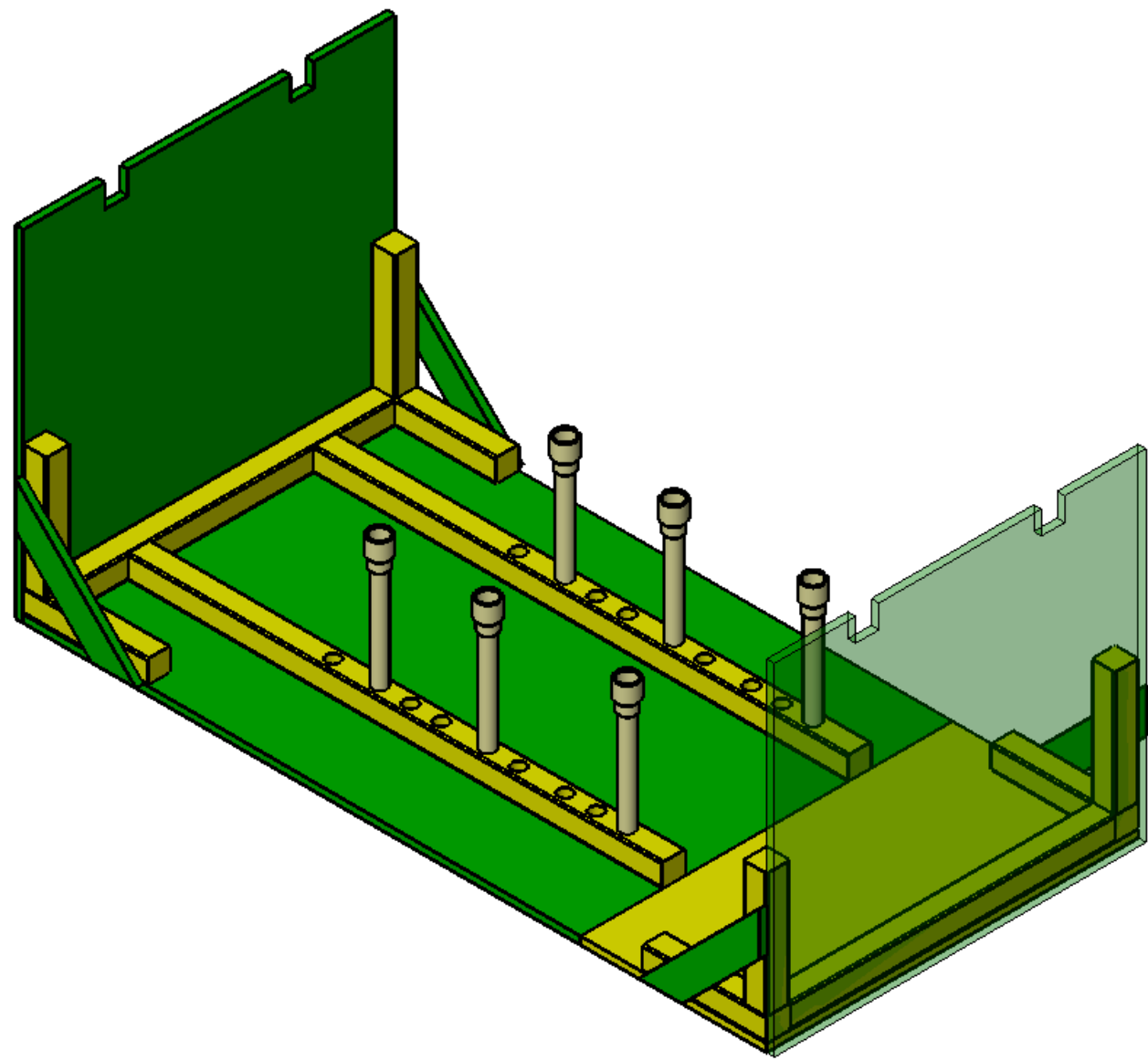
The Final Report and Drawings are archival documents that provide a complete and permanent record of the design.

4.14.3 Report Format

The format for the final report will be communicated to the design teams by the client by 4/9/2010

4.14.4 Drawing Format

- Subsystem Drawings
 - Assembly drawing(s) of entire system and all subsystems including *bill(s) of materials*.
 - Circuit schematic(s) for entire system.
 - Detailed drawings of parts that must be manufactured



UNLESS OTHERWISE SPECIFIED:			Baylor University		
DIMENSIONS ARE IN INCHES TOLERANCES: FRACTIONAL $\pm 1/64$ ANGULAR $\pm 0.5^\circ$ TWO PLACE DECIMAL ± 0.05 THREE PLACE DECIMAL ± 0.005					
	NAME	DATE	SIZE	DWG. NO.	REV
DRAWN	B. NEWBERRY	9.14.2010	B	Test Stand	
CHECKED			SCALE: 1:2		SHEET 1 OF 1
APPROVED					