**973 Portable Pit Modules Project**

**Background**

A efficient functioning pit is essential to the success of the team competing at regional, off-season and championship events. Having the right tools materials, spare parts and functional is important to the team's winning edge. At Championships we must minimize the traveling weight of our pit, therefore minimizing the tool and parts inventory to bare minimums. The regional events however focused here, are different. We are afforded the convenience of a more enhanced pit as we are able to travel with a larger variety of items at a local event. Historically, we are performing more complex tasks in the pit at regionals, as we are continuing to de-bug and develop the comp robot.

The combined experience of our veteran team members and mentors have brought forth many useful ideas for the development of the new “super-pit” modules. Below is an illustration of how many of the nessesities of the competition season are approached with this new piece of equipment. The attached drawing is a work in progress. There have been a lot of good ideas and suggestions from all of you as the final design details are developed. Your input is appreciated.

**Features Addressing Basic Requirements**

* **Physical properties to fit allotted space in venue and team trailer.**

The "Super-Pit" pit consists of two 80” x 28” modules mated together with latches, in the venue to form an “L” shape that fits in conjunction with the team’s drawered tool cabinet, to fit within a 9’ x 9’ allotted area. The floor space that remains has a regulation style carpeted center panel out to the concourse surrounded by a "U" shaped array of fatigue mats. Each module has a full 80” x 28” cladded work surface. "A" Module is adjacent to the concourse, while "B" Module is across the back of the pit next to the tool chest. Each of the wheeled lower sections, hold approximately 34 Cu. Ft. each and are designed to efficiently hold the weight and volume of 8 to 10 storage totes, the battery cart, and other dedicated equipment for transporting and deployment.

The upper sections of the modules have 2 rows of 80" x 12” deep shelves designed to hold all of the traveling “Red Parts Bins” and other items. The modules have an upper deck over the work surfaces at 80” above the floor for the storage of light bulky or flat items. This overhead deck is perforated sheet metal to allow light from the venue through and visibility to what is stored above. It is understood there are regulations regarding overhead storage over work areas. There is room on the modules to store lengths and sheets of raw materials. The items that comprise the pit bay such as fatigue mats, and carpet are designed to travel within and be deployed into the venue in the modules.

**Features Addressing Basic Requirements (Cont.)**

Each upper section has a hinged backdrop screen behind the work bench. These panels partition our pit from our neighbors. They can also be opened to share some bench top space with a neighbor or to allow manipulation of a larger item on the bench top.

* **Bench top tools and equipment**

This includes accommodation of a 9" vertical band saw, small drill press, belt sander, and arbor press. The base plates of these items are provisioned with felt padding. The items have a docking area in the far corner of the "L" shaped bench out of the way. They are fastened for transport with thumb bolts in dedicated locations where upon use, they are unfastened and slid into working position on the bench top, in some cases re-secured. The 4" vise is permanently mounted on the corner near the tool chest. A compact light weight 30" sheet metal Brake. (Harbor Freight Item # 67240) is provisioned primarily for forming of polycarb sheet, an activity very common at regional events as we finish specific shielding on the comp robot. A bench top anvil disk is provisioned with felt base and docking anchorage to facilitate occasional need to beat something with a hammer. This steel item can be positioned over the edge of the bench to accommodate some more aggressive forming without damaging the bench top.

* **Compressed Air and Vacuum**

The dedicated air compressor is mounted in a sound-proof ventilated box in the back corner of "B" Module base section. Air is piped to dedicated quick-connects on the module work bench and pit bay arm. Dedicated vacuum cleaner hard piped to a few locations with vacuum hose receptacle on the module work bench and facing pit bay. Vacuum implementation is done with an 8' hose, also with a dedicated storage location.

For traveling, the module must fit under the doorway of the team trailer at 69”, a height too short for practical use. Therefore the upper sections retract to an overall height of 68” for loading and travel with a telescoping feature built into the upper support posts. The modules are designed to travel fully loaded. Gas springs assist the Delrin-guided posts for lowering and raising to the 80” height where it is pinned in place. The lowered pinned position is also used in the trailer to keep the center of gravity down. The modules are designed to travel in the trailer secured against the two side walls with dedicated anchor points.

* **Electrical and Lighting**

The electrical requirements in the pit can be extensive, particularly the small load items. An abundance of electrical outlets are hard-wired within the modules. The pit modules are fully prewired with 120V AC receptacles, 12V DC Johnson connectors, USB charging receptacles, data cables to and from Programmers area, and overhead lighting above the work surfaces and in the pit bay. Dedicated areas of receptacle banks accommodate our portable drill chargers, computers, compressed air, power tools, the battery cabinet, and convenience receptacles. One single point of connection at the end of one module accommodates our input power cord coming from the venue. There is one short mating cable connecting the 2 modules. All other wiring to receptacles is internal within the two pit modules.

The lighting at regional events in many of the large spaces is often inadequate not supporting enough light for the pit activities, requiring measurement and inspection. Dedicated halogen lighting fixtures are provided over the module bench tops. A two-jointed arm with lighting is provided off of one of the modules that can be positioned over the center of the pit bay over the robot, giving us a boost in efficiency and safety with adequate lighting.

* **Programmer and Data Areas**

Code writing and testing on the robot can get very intense at a competition in the pit. Historically the programmer has sat on a bucket with a notebook computer on their knees with several feet of cables and power cords around their feet. The pit modules will have some features to help support this valuable part of our team effort.

Designated area for programmers to work will be accommodated with a drop-down table on the concourse end of one of the "A" module for the programmer to use as a work station. On the end of the module where the table is deployed, are 120V receptacles, lighting, and data ports. A secure location for Cat 5 cable tether to robot and a switch to strobe light when programmer has robot “enabled” in the pit is accommodated.

A pit CPU and printer is dedicated in the modules. A monitor is located inside the module for viewing and operation from the work bench. A second 22” or larger flat-screen monitor and speaker is mounted and prewired on the concourse end of the modules to display team information or stream ongoing matches. A whiteboard is also accommodated on the modules.

**Benefits to the Team Effort**

* **Speed of Setup and Teardown**

Generally there is a limited access time for pit load-in at the regional. The sooner the pit is functional the sooner that any pre-event mechanical and code work can begin. The locations for the tools and equipment for the most part reside in the same location for travel. Once the pit is rolled into place in the venue, the top racks are raised, and the two modules joined with latches. Electrical is then plugged in and it is functional in a matter of a few minutes.

At the end of a regional there is often limited time to tear-down the pit. There is typically some components being removed from the comp robot for improvement in the shop, and packaging of the comp robot. Everyone is tired and the job still needs to be done efficiently. With most everything traveling where it functionally resides in the pit, teardown is a minimum amount of time. Load-out works the same as load in, with three major packages.

As the modules are easily deployed the team may choose to roll one or both of them out to elimination rounds in some circumstances, as easier than moving smaller individual chunks of gear.

* **Use of Pit Module units as Staging of Traveling Tools, Parts and Hardware, Pre-Event**

Historically there are many Atascadero shop activities for carry-in hardware for the comp robot that are going on the eve of the travel day to a regional. The important task of loading the shop tools and parts bins into the trailer has in the past been a conflict with the equally important last minute shop work. This sometimes leads to parts and tools left behind or an overkill of last minute items piled into the trailer due to the late production work.

A transition to the pit modules a few days prior to load-up night, would lessen the problem. The parts bins would be secured for travel in the same location as they are accessed for use. The fully staged modules would be easily accessible to the shop while secured in the trailer. In this way, the load up for a regional event is not delayed and production is not obstructed.

As the modules are self-contained they may be used prior to leaving for an event as an extension to the shop, even when secured in the trailer. The modules may also serve the team at the practice field between events.

* **Efficiently moving hundreds of pounds of team tools, parts and equipment into the venue.**

The two modules together with the rolling tool chest are designed for portage of the entire pit, less robot. The size of each are designed to pass through a 30” doorway. The modules are equipped with high capacity 4” casters with brakes. Fixed casters to be provisioned with more efficient brakes operated at waist level for controlling portage on inclined surfaces.

* **Safety of Setup and Operation**

A minimum amount of lifting is necessary for setup as items residing for travel, are typically where they are placed in the working pit. The gas lift assisted raising of the upper sections also reduce the need for heavy lifting. The team’s battery cart weighs over 200 lbs fully loaded with 10 batteries. Cart is strapped into the front module in a dedicated battery cart track, close to floor for transport and in the working pit. Fully loaded battery cart is rolled onto floor as necessary i.e. elimination rounds, on deployable ramps saving time and potential lifting injury. Dedicated power at cart location eliminates tangles on floor.

A first aid kit, fire extinguisher and small portable eyewash will reside in dedicated locations on the pit modules. A small 12 x 12 x 12 flammables cabinet could be considered for the pit modules. In operation, a perpetual JSA or “Job Safety Analysis” will travel with the modules and a short “Tail Board “ safety meeting will precede the load-in to the venue for those involved in setup and the pit crew.

**Electrical FRC Compliance and Electrical Safety**

A portable ground-fault interrupter will be placed in line for the connection from the venue, to reinforce our commitment to electrical safety. A dedicated panel mounted ammeter will be provided to assure to the FRC inspector that our combined electrical loads do not exceed the 10 amp maximum set forth by FRC. Electrical service to vacuum and compressor on a single pole double throw, center-off switch to avoid combined loads and to shut off equipment.

Sensitivity to electrical safety and temporary power rules by FRC inspectors is expected. The installation of the modules electrical systems during fabrication is to be supervised by a licensed electrician per Uniform Electrical Code. A schematic for the modules will be drafted. The system design is to be certified in a fashion to lend credibility and respect from FRC inspectors that may be wary of pre-wired custom electrical systems brought into the venues. Records of design and inspection are to travel with the modules for this purpose. The Pit Captain is to be briefed on the potential presentation of this data to FRC inspectors.

* **Organization and Housekeeping and Efficiency**

The pit is a small area with a lot going on within it. A place for everything and everything in its place is important for efficiency and safety. The increased storage and organizational space in the modules helps with this taking some load off of a congested tool cabinet. Paper towel holder, dust pan and broom have dedicated locations on the modules.

* **Security**

Although thefts at the regional events are rare they have happened to the team in the past. It must be easy to secure some important items like notebook computers, phones and the like within the pit. A lockable vented cabinet is provided in the modules to leave unattended electronics ect. In the pit. An electrical receptacle is provided within the secure cabinet that could accommodate charging while secured.

* **Team Image and PR**

The pit should be a reflection of our team's attention to detail, elegance in design, professionalism and spirit. The pit modules will help to convey that. The modules have sockets built into the upper structures for the deployment of support poles for team banners. The Upper fascia panels have room for our team name, seasonal sponsors or perpetual sponsors that contributed to the construction of the pit modules. The dedicated pit CPU and outward facing monitor can display team related slideshows or videos.

**In Conclusion**

The new "Super-Pit" will be a valuable investment for the team for image, efficiency and safety. Special Service Contractors has donated $1,000.00 this year to the team for this project and a weld shop to fabricate it in. There will be some additional funding needed to fully accommodate the project. As the project is designed an estimate of materials will be developed for a target. There may be some plan for perpetual sponsors that would have their name on the pit permanently for their donation to its construction. This and other ideas need to be discussed further.

Thank you for you help and ideas for this project as it is developing.

Scott and Allen Bailey