2017

Design Brief
Level 3: Spatial Design
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Welcome

The SUBs in Schools Spatial Design program challenges year 9 to 11 school students to design and build a virtual galley or berth environment for a submarine. The program aims to create an exciting and fun learning environment for students. If time permits students are encouraged to go beyond the manual, be creative and innovative extending the process. Some of the problems students will face when designing the submarine will be similar to challenges faced by engineers building a full scale submarine.

The program will expose students to 3D CAD/ CAM packages, virtual rendering software whilst providing construction challenges that will provide opportunities for creativity. It will also help them to develop students problem solving skills, and team them about working and contributing in a team environment.

It is an ideal design build for the schools who do not have a significant Design and Technology workshop facility as most of the process can be produced with minimal expense. Some schools do not have internal D&T classrooms capable of building a large-scale model of either an ROV or a submarine. This level of the competition will allow these schools to participate in a complex STEM program without being disadvantaged.

The task is to form a virtual design company, which will make a bid for the design of an accommodation space on-board the Future Submarine Project. The students will have to build a virtual 3D model of the accommodation space (i.e. galley or sleeping space) as well as a physical 3D model of their space and then present their design to a team of industry judges. The winning teams will have the opportunity to undertake some high-level industry visits, possibly overseas.
Design Brief

Australia is about to launch its next generation of combat submarine within the next 5 years. You’ve seen a business opportunity and decide to start up your own small business venture in the form of 3 to 5 staff. You intend to design the internal galley (kitchen) or sleeping quarters (berth) within several months and present your results to the board of Australia’s’ next generation submarine.

As a newly formed company you’ll need to form a well structured organisation. Each member of your team needs a clear role, title and equal workload for the duration of the project. You’ll need to create marketing material and start building awareness for your brand and an established front. This could be done through the development of logos, advertisement, media exposure, social media, marketing materials or networking.

You will need to form industry connections to build a network. As you’re new to the submarine industry you’ll need to get up to speed quickly and efficiently on what the latest trends are and have portals to access this information.

Industry connections will aid in progressing your ideas, accessing information you could otherwise not find elsewhere. An industries pre-existing knowledge is the foundation on which you build. As a new business, you’ll need to get up to speed quickly on all things submarines, understand how the crew use the submarines spaces. What considerations are going to set you apart from the rest when you make your end of year pitch to the directors. Consider this as you progress through your project, a point of difference can go a long way.
Option 1 - Kitchen (Galley)

Background information

The galley is a confined space is used by 2-3 chefs to prepare, cook and plate food for a crew of 60 submariners. It’s a hot, cramped tiresome job and any ideas to ease the difficulty will go a long way. The style of food cooked is typical of items you cook at home, burgers, lasagne, pasta, pizza etc. A typical time aboard a submarine is 6 weeks.

Considerations

1) Layout
This is one of the most important aspects of the design, as the cooks will be working in a confined space you’ll need to consider how they move about a kitchen and work in unison as a team.
• What is the flow/ process of preparing, cooking and serving food in a kitchen?
• Do chefs use stations in a kitchen to complete different tasks?
• How do the chefs access the raw ingredients, through to disposing of the food waste?

2) Storage of food
Space is a premium on board a submarine so a conventional home pantry might not be the solution. How do you bring a sense of structure and organisation to the storage of food?
• Where is the food stored?
• How is the food stored? is there an order to access the ingredients?
• How do the chefs access food to begin cooking?

3) Disposing of food waste/ rubbish
• How do you dispose of food waste?
• How do you consider minimising the space rubbish will take up on board a submarine?
• Will there be an odour from the rubbish you’ll need to consider?

4) Appliances
• Commercial appliances vs submarine kitchens, what’s the difference?
• What type of stove top/ oven do you use? Natural gas, LPG, electric? What justification do you have for choosing this heat source?
• Size of appliances for efficiency vs size?
• What appliances do you need?

5) Human Ergonomics
How high do you make a bench top, or an oven, how deep a bench? All these type of considerations are related to human ergonomics.
Option 2 - Sleeping Quarters (Berth)

Background information

The crew on a submarine can vary from mission to mission, sleeping 40 to 60 crew in an Australian submarine. Some American nuclear submarines can sleep up to 160! How can you design a space that can accommodate a fluctuating crew size, possibly allowing the space to be used for another purpose?

Considerations

1) Use of space
In a submarine it is very difficult to have time to yourself, one of the only opportunities you have is in your bunk, out of social activities.
   • Lower ranking crew may need to share beds at different times, meaning one crew member may be leaving as the next arrives to go to sleep. How could you assist in this transition? The loss of space in which you can call yours and store some private possessions?
   • Can you sit up in bed or only lay down?
   • How can you personalise the space? This may include a photo of the family, an area to store jewelery/ watches, books/ Kindle/iPad.
   • Can you incorporate an opportunity for them to sit? Lighting for reading without disturbing others?

2) Storage of personal items
   • How do you give a crew member an area where they can use as they please? To store an array of personal items?
     - Storage of spare linen/ pillows
     - Entertainment
     - Modular space
   • How can you utilise the space more efficiently? Can you remove bedding for a spot to read or play video games.

3) Human Ergonomics
With a growing number of women entering the submarine work force how do you accommodate the differences?
   • How do you allow men and women to coexist in a confined space but have privacy when changing clothing, showering, going to the bathroom and sleeping?
1.  Model of Chosen Environment

1.1 Virtual Model
Produce a virtual 3D CGI (Computer Generated Image) model of your chosen submarine space. It MUST be produced in a way to exhibit the entire space, either as a video presentation or as an interactive walk through. You MAY use any 3D software package to design components and the virtual model ensuring you’re able to produce the desired outcomes.

The virtual model may be assisted through the use of virtual reality goggles, training simulation programs or a voice over, etc.

Depending upon the complexity and in-depth approach you take with the virtual model you may opt to have a scale model to assist in the explanation of your design.

1.2 Scale Model
If you choose to produce a physical 3D model of the virtual design it MUST be at 1:10 scale.

The scale model should be used to assist your virtual model in explaining your innovative elements. The scale model MAY exhibit elements of your designs or be a complete assembly of your environment. It is open to your discretion for you to choose the best way to exhibit your designs. If you feel your virtual model is intuitive and descriptive enough you MAY choose not to produce a scale model to assist your sales pitch, a scale model is optional.

2.  Project Portfolio
The portfolio MAY be divided into two sections, first 10 pages about your team and the following 10 pages your pitch.

Create a 20-page folio covering each of the main elements of the project and examining associated design influences such as:
- Team roles and duties,
- The science behind underwater operation and acoustic signature of their design,
- Human environment design including energy generation, usage and storage on board the submarine and propose alternative and innovative energy solutions that could address areas such as, lighting, cooking, food storage etc.
- Examination of key issues associated with sustainability, recycling and handling of human and food waste.
- A detailed study of hydrodynamics and the impact of buoyancy, pressure and stability of their design,
- Industry collaboration,
- The design cycle and Innovation,
- Company Marketing Strategy
- Sponsorship

3.  Trade Booth
Produce a trade booth – usually a 2m (w) x 1m (D) x 2.4m (H) expo style booth aimed at selling your virtual company’s products to the Department of Defence. This will include the development of their company uniforms.

4.  Verbal Presentation
Prepare a 20-minute verbal presentation.

You MUST cover the each members role, title, members design(s) for presentation to a body of suitable qualified Managers, Engineers and Scientists from the Department of Defence and Future Submarine Integrated Product Team.
Article T1 - Definitions

T1.1 Language Used
The language of the rules is tiered. Those clauses expressed as ‘MUST’ or ‘WILL’ are mandatory and failure to comply will attract objective penalties - points and/or in the extreme, disqualification. Those expressed as ‘SHOULD’ or ‘MAY’ reflect some level of discretion and choice.

Some clauses will be satisfied through team registration processes or declarations signed as complied with as part of the Challenge Terms and Conditions, whilst others will be tested through a variety of objective and subjective judging.

T1.2 Spatial Design
This is also referred to as ‘the model’, ‘galley’ or ‘berth’ and MUST be designed and manufactured according to these regulations for the purpose of participating in competition at a State or National Final event.

T2.1.1 Galley
Galley is a kitchen, an area of the submarine where chefs will store, and prepare food for the crew.
A SUBS in Schools ‘galley’ model assembly MUST consist of the following mandatory components and/or features:
• A frame (no larger than the dimensions provided)
• Appliances
• Storage areas
• Rubbish disposal
• Decals

T2.1.1 Berth
Berth is a bedroom, an area of the submarine where the crew can go to sleep, rest and recuperate.
A SUBS in Schools ‘berth’ model assembly MUST consist of the following mandatory components and/or features:
• A frame (no larger than dimensions provided)
• 12 crew beds
• Personal Storage areas
• Lighting
• Decals

T1.3 Penalties
A range of penalties will be applied for non-compliance with identified regulations. These penalties include:
Point Penalty: Invoked from non compliance with technical regulations and some competition regulations governing portfolio or trade booth restrictions. These are identified as [Point Penalty].
Eligibility: Teams need to meet certain eligibility criteria to compete at a State or National Final. Failure to comply with certain eligibility criteria MAY lead to disqualification from the competition, a judging element or a class of competition [Eligibility].

T1.4 Decals
A surface finish on a SUBS in Schools sub is considered to be any applied visible surface covering the profile of a sub component. A decal is material adhered to a component or surface finish. To be defined as a decal, 100% of the area of the adhering side MUST be attached to a surface. Surface finishes and decals are included when measuring the dimensions of any components they feature on. Refer to the Competition Regulations for more information. Teams are advised to take extra caution when producing their own decals as all logos MUST adhere to published Branding Guidelines.

T1.4.1 SUBS in Schools Logo Decal
This consists of the SUBS in Schools logo graphic printed on either black or white. Teams choose to use either the black or the white background decal so as to provide maximum contrast with the colour of the surface the decal is being adhered to. Official decals are supplied by REA Foundation Ltd prior to event registration. A team can manufacture and fit their own decals, provided they are the correct size, colour and graphic design. Optionally, a thin black or white key-line border may be included on the black or white background decal. Refer to the Competition Regulations for more information. The SUBS in Schools logo must have minimum dimensions of 90mm x 50mm.
T1.4.2 REA Foundation® Logo Decal
This consists of the REA Foundation Ltd logo text and globe graphic printed on either black or white. Teams choose to use either the black or the white background decal so as to provide maximum contrast with the colour of the surface the decal is being adhered to. Official decals are supplied by REA Foundation Ltd prior to event registration. A team can manufacture and fit their own decals, provided they are the correct size and colour. The REA Foundation logo must have minimum dimensions of 90mm x 50mm.

T1.4.3 Australian Government - Department of Defence Logo Decal
This consists of the Australian Government Department of Defence logo text and coat of arms graphic. Teams choose to use either the black or the white background decal so as to provide maximum contrast with the colour of the surface the decal is being adhered to. Official decals are supplied by REA Foundation Ltd prior to event registration. A team can manufacture and fit their own decals, provided they are the correct size and colour. Sizing MUST be such that all text is clearly legible. The Department of Defence logo must have minimum dimensions of 90mm x 50mm.

T1.4.4 SAAB Logo Decal
This consists of the Saab logo graphic printed on either black or white. Teams choose to use either the black or the white background decal so as to provide maximum contrast with the colour of the surface the decal is being adhered to. Official decals are supplied by REA Foundation Ltd prior to event registration. A team can manufacture and fit their own decals, provided they are the correct size and colour. The SAAB logo must have minimum dimensions of 60mm x 30mm.

T1.4.5 ASC Logo Decal
This consists of the ASC logo graphic printed on either black or white. Teams choose to use either the black or the white background decal so as to provide maximum contrast with the colour of the surface the decal is being adhered to. Official decals are supplied by REA Foundation Ltd prior to event registration. A team can manufacture and fit their own decals, provided they are the correct size and colour. The ASC logo must have minimum dimensions of 60mm x 30mm.
T1.5 Engineering Drawings
CAD produced drawings which should be such that one could theoretically be used to manufacture a fully assembled galley or berth by a third party. Such drawings SHOULD include all relevant dimensions, tolerances and material information. SUBS in Schools engineering drawings MUST include detail to specifically identify and prove compliance to the overall size of the space.
Article T2 - General Principles

T2.1 Regulations Documents
REA Foundation Ltd. issues the regulations, their revisions and amendments made. Technical Regulations - This document. The Technical Regulations document is mainly concerned with those regulations that are directly related to SUBS in Schools ROV design and manufacture. Technical Regulation article numbers have a ‘T’ prefix. Competition Regulations – A document separate to this one which is mainly concerned with regulations and procedures directly related to judging and the competition event. Competition Regulation article numbers have a ‘C’ prefix.

T2.2 Interpretation of the Regulations
The final text of these regulations is in English should any dispute arise over their interpretation. The text of a regulation, diagrams and any related definitions should be considered together for the purpose of interpretation. Text Clarification - Any questions received that are deemed by REA Foundation Ltd. to be related to regulation text needing clarification will be answered by REA Foundation Ltd. The question received, along with the clarification provided by REA Foundation Ltd. will be published to all competing teams at the same time on the REA Foundation Ltd. website.

T2.3 Amendments to the Regulations
Any amendments will be announced and released by REA Foundation Ltd. by email notification to all teachers nominated in the school registration, as well as the updated revision being uploaded to the website at http://rea.org.au/subs-in-schools/. Any amended text will be indicated thus (using red underlined text).

T2.4 Safe Construction
All submitted models will be inspected closely to ensure they are engineered and constructed safely for the purpose of display. If the judges rule any aspect of the ROV to be unsafe for display, the team will be given an opportunity to rectify issues without penalty. Failure to rectify any unsafe issues prior to the commencement of judging will result in the model being withdrawn from the display and no points awarded.
Article T3 - General Virtual Model Regulations

T3.1 Design
T3.1.1 All virtual models MUST be designed using CAD (Computer Aided Design) and CGI (Computer Generated Image) technology. Your chosen CAD software should be capable of 3D part modelling, assembly, 3D realistic rendering and animation/ motion renders.
T3.1.2 Models MUST be produced with dimensional accuracy and scale.
T3.1.3 The virtual walk through or interactive walk through MUST be produced using CGI software. You MAY assist your models effectiveness through the use of virtual reality goggles, training simulation programs or voice overs.

T3.2 Finishing and Assembly
T3.2.1 All virtual models are expected to be assembled in CAD software and MUST reflect the features and intended function of the chosen space.
T3.2.2 Editing software such as Photoshop MAY be used to assist with enhancing the renders as long as no details are removed or altered from the original design.
T3.2.3 All renders are expected to be completed with appropriate levels of surface finish, representing the true colour and texture of a real end product.

T3.3 Decals
T3.3.1 REA Foundation Ltd. Corporate Logos - These decals MUST be displayed in all virtual models. An electronic file, JPEG or PNG will be supplied with appropriate instructions to all State and National Final teams.
T3.3.2 Minimum dimensions - The REA Foundation Ltd. Department of Defence and SUBs in Schools logos MUST have a minimum scaled dimension of 300mm long x 150mm high.
T3.3.3 Positioning of Logos - Logos MUST be visible from the centre of the passage way. Logos MUST be visible during the video walk through.
Article T4 - General Model Regulations

T4.1 Design, Manufacture and Construction

T4.1.1 All scale models MUST be designed using CAD (Computer Aided Design) technology. CAD software should provide for 3D part modelling and assembly. CAM (Computer Aided Manufacture) software MAY be used to assist in the production of a model.

T4.1.2 Models MUST be produced with dimensional accuracy and scale.

T4.2 Finishing and Assembly

T4.2.1 All models MUST be produced at 1:10th scale.

T4.2.2 You MAY opt to produce a complete assembly or a partial model, showing the elements you wish to highlight.

T4.2.3 You MAY produce elements by hand but particular attention must be made to maintaining dimensional accuracy and scale.

T4.3 Model Decals

T4.3.1 A sticker sheet with appropriate instructions will be supplied to all State and National Final teams.

T4.3.2 Minimum dimensions - The REA Foundation Ltd. Department of Defence and SUBs in Schools logos MUST have a minimum scaled dimension of 30mm long x 15mm high.

T4.3.3 Positioning of Logos - Logos MUST be placed on the outside of the model, visible without moving or altering the model in anyway.

T4.4 Safety

T4.4.1 The model MUST have no sharp edges, be produced out of a unfit material or it will be deemed unsafe for display.

T4.4.2 The model MUST have adequate strength to support its own weight or require any supports for display.

T4.4.3 If the model requires power it MUST not have any exposed electrical connections. The model MAY be supplied by mains power (240v) but MUST be reduced to 12v for circuitry contained within the model.
Article T5 - General Regulations

T5.1 Overall Size
The completed assembly must fit within the dimensions shown. All design features and elements MUST stay within the constraints of this space.

T5.2 Passage Size
The passage width MUST be no less than 600mm in width and no less than 1800mm tall, to allow crew to pass in and out.

T5.3 Berth
The regulations for berth are only applicable if you are working on the berth design brief.

T5.3.1 Crew Capacity
You MUST provide an area for rest and relaxation for a rotational crew of 24. The crew are on 12 hour rotations, 12 hours at work, 12 hours sleeping/relaxing.

T5.3.2 Berth Operational Requirements
The berth MUST have an area large enough for a 95% male to sleep comfortably. The crew MUST be able to securely store personal items and change the bed sheets quickly for crew change over.

T5.4 Galley
The regulations for galley are only applicable if you are working on the galley design brief.

T5.4.1 Crew Details
The submarine can acquire a crew up to 60 submariners. A typical voyage on board the craft is 6 weeks. The crew consume 4 meals a day, breakfast, lunch, dinner and supper. You MUST cater for the entire duration of the expedition.

T5.4.2 Chef Details
There are 2 chefs in the galley at one time. You MUST accommodate for multiple chefs in the galley environment.

T5.4.3 Kitchen Operational Requirements
The galley MUST be capable of storing food, preparing food, cooking food. This MAY be completed via a number of methods.
Human ergonomics MUST be considered as you design these spaces.