5 Activity planning using number

An important numeracy skill, much in demand by employers, is the ability to plan complex activities. This may present challenges in data collection, problem solving and communication, in addition to requiring a variety of calculation techniques.

Activity planning often involves analysing a complex task and breaking it down into smaller components, scheduling these components in a logical sequence, and estimating the time for each component and for the overall task.

Activity planning may require the calculation of quantities of materials or resources required for a task, which in turn may involve the measurement or estimation of lengths, areas and volumes. It may be necessary to calculate the cost of materials and other necessary expenditure.

The results produced when planning an activity will need to be presented in an appropriate format for the persons who will carry out the task. This may require: charts to show the sequence of operations; tables of materials and other resources which will be required; and maps, plans or other diagrams to show the locations or layout for the task.

In a workplace environment, the employee carrying out activity planning may be required to produce a written report or give a verbal presentation to managers and colleagues as a **feasibility study**. This allows the costs, timescale and any potential problems to be assessed before a decision is made on whether or not to proceed with the activity.

As a first example of activity planning during vocational courses, we look at a planning task for construction students…

House renovation in terrace

There can be considerable benefits in developing numeracy skills in the context of a realistic construction project. Employers have expressed concern that students joining the workforce are often only able to carry out precisely defined calculations of the types found in GCSE mathematics examinations. Students have difficulty in assessing the less well defined requirements of a real world task, deciding on the calculations which are necessary, and choosing appropriate mathematical techniques to carry out these calculations.

In addition to developing problem solving skills, the use of realistic workplace scenarios can be more motivating for students. Gorse et al. (2008) advocate the use of multimedia case study material for developing numeracy within construction courses:

> There is a school of thought that maths set in a real context has greater relevance to students than theoretical maths that is taught without specific application.

> Capturing the interest of those studying maths is a key agenda for government as the general standard of maths in the UK is falling. Construction students that struggle to see the importance of maths and fail to recognise its use may benefit from multimedia applications that present the maths in a real context. In a virtual environment, with images taken from real sites, it is possible to apply maths to construction situations bringing the subject to life.

Effective resources could be developed in a variety of formats for presenting numeracy case studies in construction. We describe here a set of work sheets for the project **'63 Bute Street'**, produced by ILEA Learning Resource Branch. In this scenario, students are asked to carry out an extensive series of planning activities for the renovation of a terraced shop premises with living accommodation above.

Plans of each floor of the building, along with elevation drawings for the exterior and interior are provided:

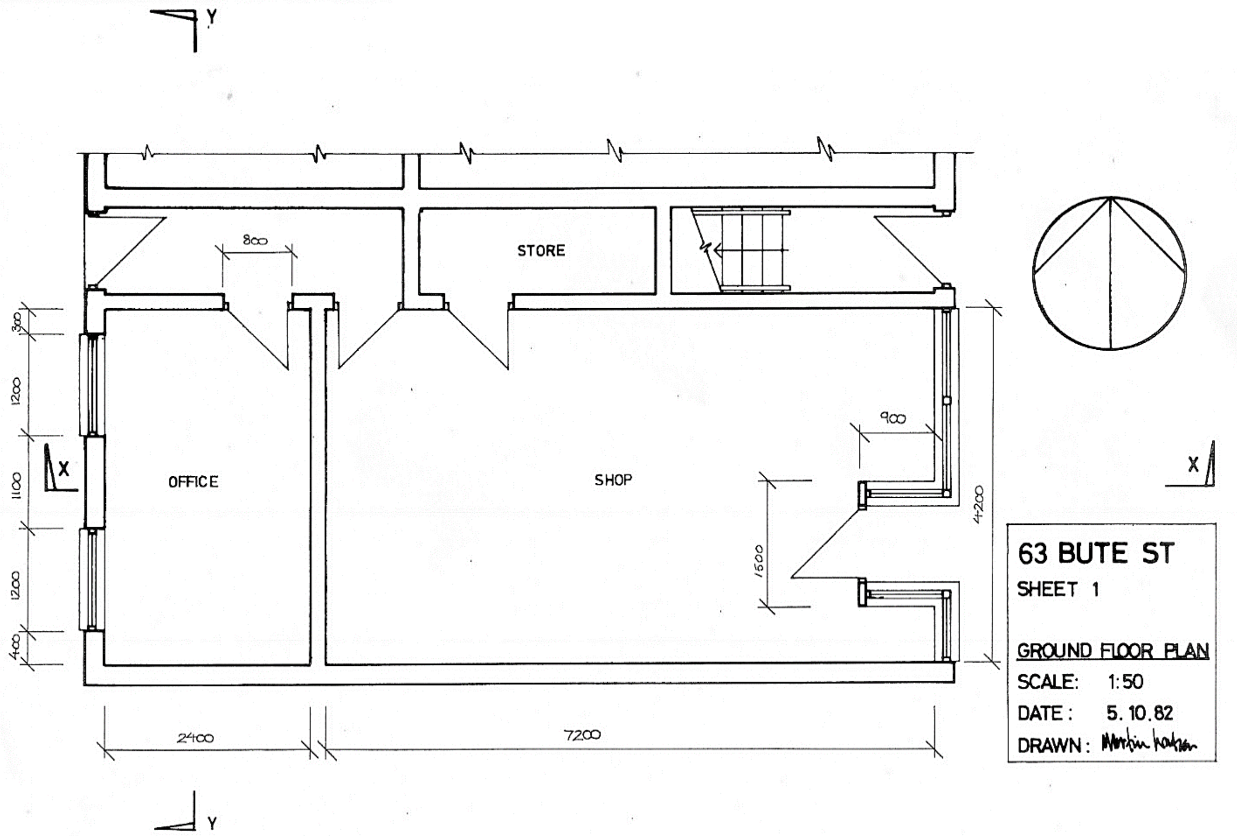


Figure 62: Ground floor plan for 63 Bute Street

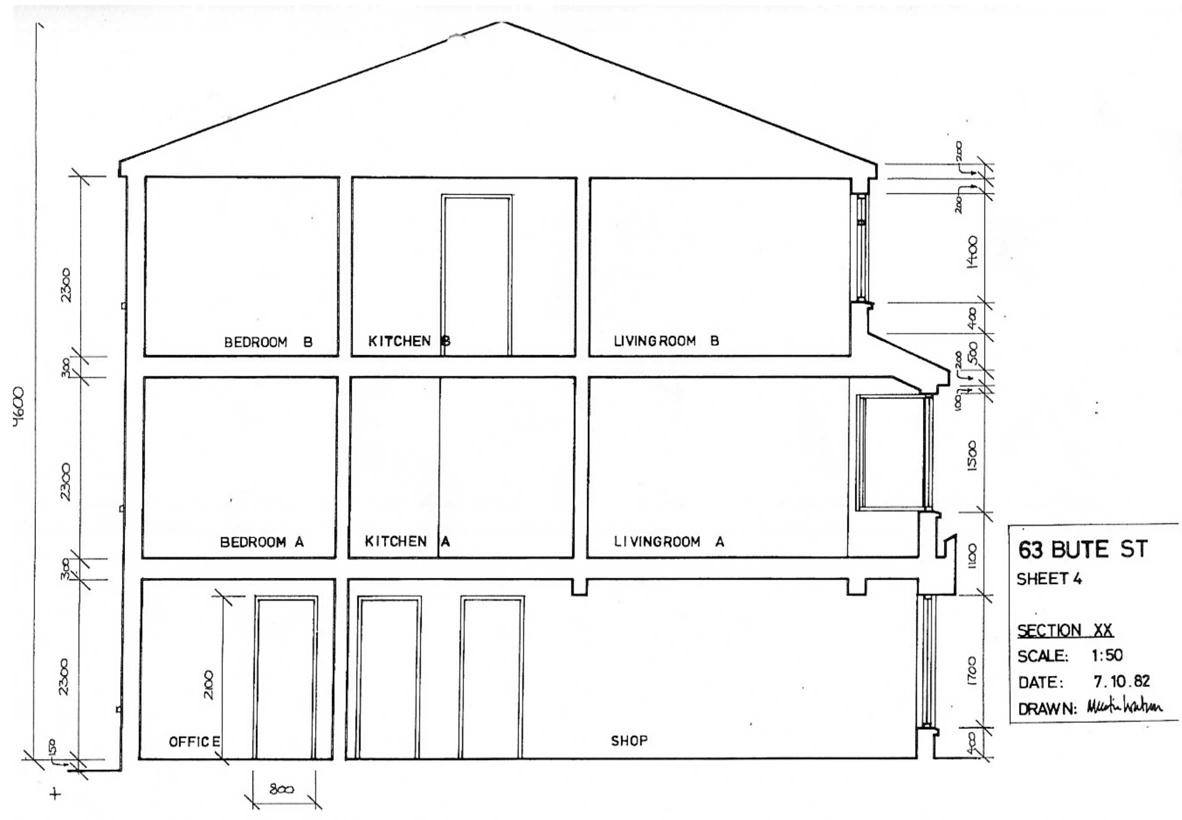


Figure 63: Interior elevation for 63 Bute Street

A series of construction activities are set out in the sections of the Case study, which include:

- carpentry, construction of partition walls and plaster boarding
- kitchen and bathroom plumbing
- tiling, decorating and carpeting
- specification of ventilation fans

Tasks involve realistic calculations for:

- arithmetic operations, including decimal numbers and conversion between different units of measurement
- calculation of percentages
- estimation

Examples are given below. When carrying out the tasks, students need to make extensive use of the plans and elevation drawings in order to obtain the required measurements.

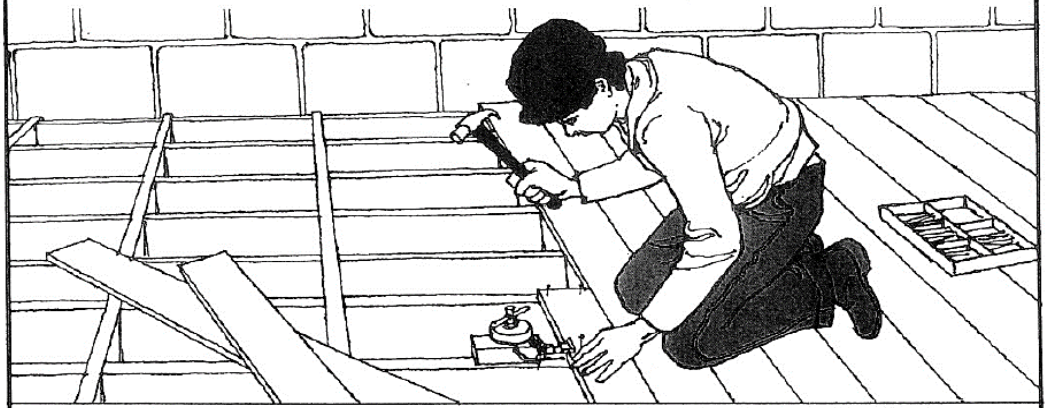
A similar approach to the 63 Bute Street case study could be developed to challenge construction students at different levels of skill. Realistic calculations might be included for concrete foundations, construction of staircases, roofing, electrical wiring and plumbing. The case study would be accompanied by actual or specially prepared architectural drawings.

63 BUTE STREET

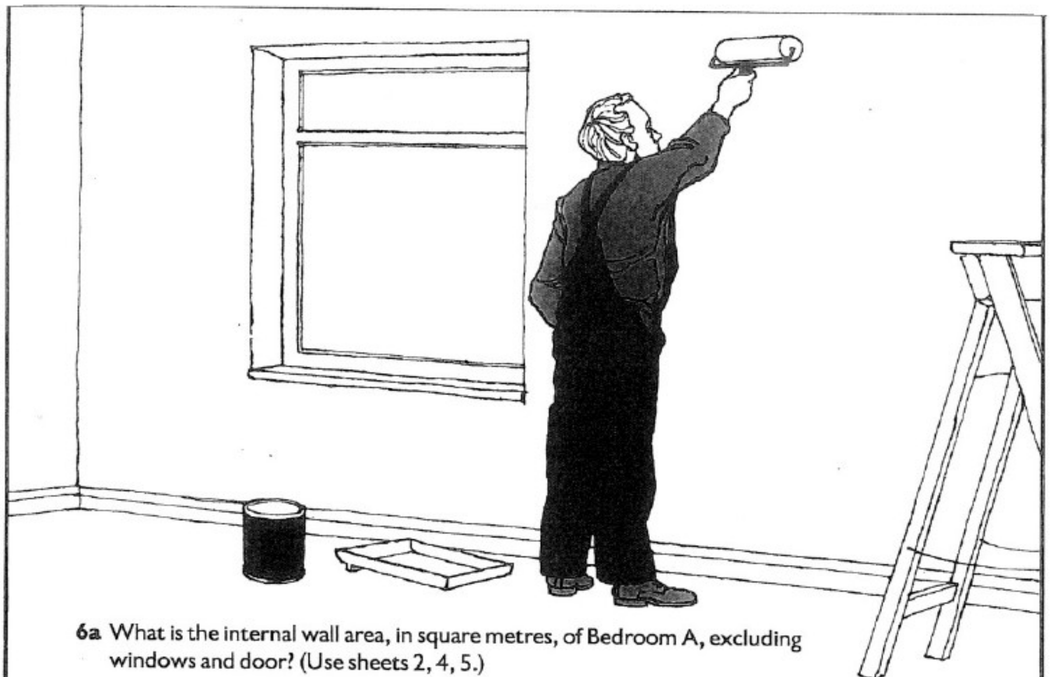
1 What is the floor area, in square metres, of Bedroom A? (Use sheet 2.)

2 The office is to have new floorboards.

How many square metres of floorboard are required? (Use sheet 1.)



3 What is the area of glass in the west window of the office, excluding the frame? (Answer in square metres. Use sheet 5.)



6a What is the internal wall area, in square metres, of Bedroom A, excluding windows and door? (Use sheets 2, 4, 5.)

Remember • The door is 2.1 m high.

b The walls are to be painted with emulsion. This costs £2.40 per litre, plus 15% VAT, and 1 ℓ covers 12 m^2.

How much paint is required for two coats, to the nearest 0.5 ℓ?

c How much will the paint cost?

Figure 64: Example tasks from the 63 Bute Street case study

Hill farm tourism venture

Our next example is a planning task presented to business studies students.

> You have been asked to create a business plan for a local hill farm, situated in the Coed y Brenin area. The current business is not as busy as it once was and the owner needs to show a way of increasing the profitability in order to apply for a bank loan to allow for further development.
> There is a farm house and out-buildings which have not been developed yet and the client has sheep on the land. Research has shown that other farms in north Wales have developed their own programs of outdoor and leisure activities, either on the farm or in the local area to increase visitor numbers. Some farms also work with local tourist attractions or outdoor centres. The owner would like you to investigate these possibilities for business development.

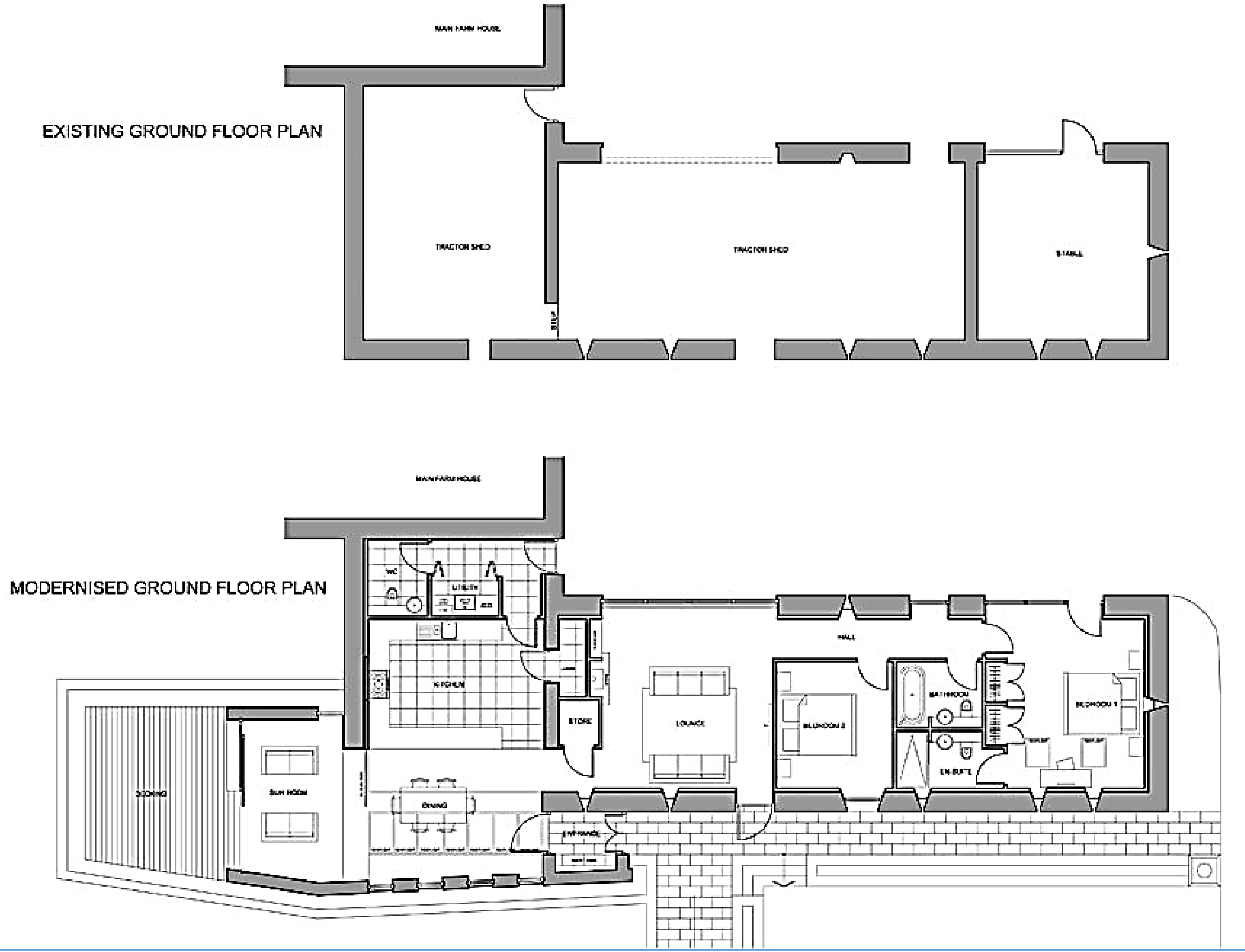
Students are given drawings and plans provided by their client, showing the land boundaries and buildings. The group is invited to present requests to the client, via the tutor, for any further details that they think they may require.

Figure 65: Farm buildings in the business planning case study

Students are asked to present a business plan in a professional manner, to include projected earnings over 5 years. The business plan should involve several stages:

- Conversion of farm outbuildings to produce accommodation for visitors undertaking adventure activities
- Planning and costing the adventure activities.
- Evaluating likely occupancy and income.

Central to the development will be the conversion of outbuildings to provide accommodation for visitors. Students may investigate case studies of barn conversion schemes and estimate the costs involved. Costs in the region of £1,000 per m^2 might be expected for a stone building.



www.md-a.co.uk/residential-architecture/shafar-stables

Figure 66: Design for an agricultural building conversion

Students should investigate factors which will affect the granting of planning permission, particularly since the development is situated within a National Park. These factors might include: building conservation, road access, and the provision of power, water, and sewage disposal.

As a first step in developing financial plans for the tourist venture, students might carry out **market research** to investigate accommodation and activities which might be offered, prices which could be charged, and the usage which might be expected in different seasons.

Students should investigate activities which would be attractive to the customers who use the accommodation, such as: mountain biking, canoeing and climbing. The client will require costings per person for each activity, including equipment hire, instruction and the cost of any transport which will be provided.

When fixed and variable operating costs have been estimated, a **breakeven analysis** is carried out.

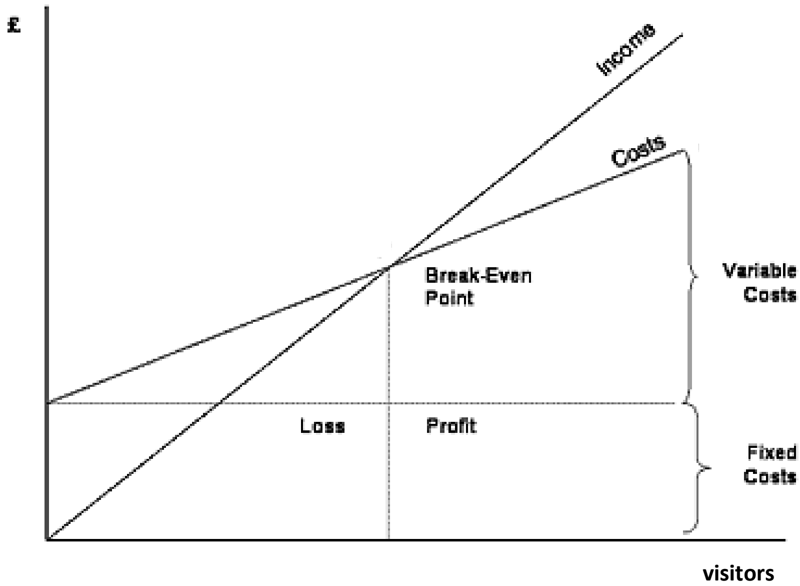


Figure 67: Break even curve, balancing income against costs

A line graph is used to estimate when total revenue will equal total costs. The point where the two lines intersect is the breakeven point.

The client will wish to know the estimated projections for repayment of the loan for the building conversion and other capital costs, including interest. Students are given a table of loan repayment terms, with examples showing repayment options.

At the end of the project, students compile their business plans and present these in the context of a formal meeting. The tutor, taking the role of a bank manager or business investor, examines the planning document and is able to ask for further clarification of the figures presented. They may challenge any of the business assumptions which have been made by the students.

It is hoped that the project will provide a wide range of experience in the broader numeracy skills which are of value to business managers, including: problem solving, communication, and working with others, in addition to data handling and mathematical techniques.

Garden design

Another substantial project which can develop broader numeracy skills is the design of a large garden. This might include:

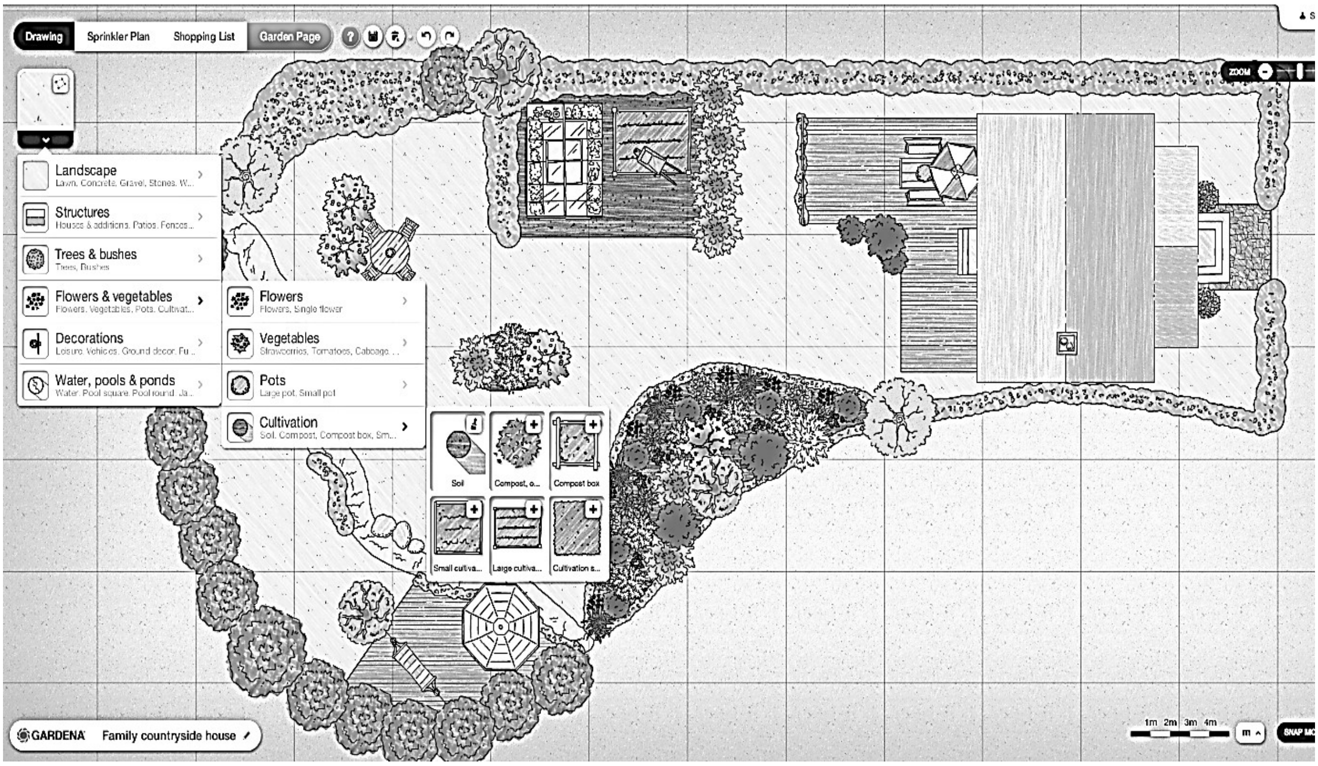
- landscaping, including the movement of quantities of rock and soil where necessary
- construction of ponds or other water features
- construction of paths, walls, decking and other structures
- planning the layout of lawns, flower and vegetable areas, and planting of trees
- addition of greenhouses, storage sheds, garden furniture and other equipment.

Students are provided with a plan of a large garden area, accompanied by photographs of the undeveloped land. The objective is to plan and produce a schedule of tasks which would be carried out over a period of a year, selecting appropriate months for construction and planting activities.

We will specify a location in the coastal lowland area of North Wales. Students should carry out research to determine the types of plants which will grow well in this mild, damp environment of slightly acid clay soil.

Software is available on-line to help with garden design; an example is given in figure 68 below. The boundary of the garden is entered on a scaled grid, then fixed features such as buildings, paths and streams can be added.

Garden design systems often have a large library of plants which can be selected from menus and positioned on the plan by means of the mouse pointer. Menu items may be linked to further information about each plant, including planting and cultivation information, suppliers and prices.



www.gardena.com/uk/garden-life/my-garden

Figure 68: Example of garden design software

The objective is to produce a development plan for the garden, including costings for materials, labour and planting. The project scenario can specify the extent to which the client will carry out the work, and the tasks which will require a specialist building contractor or landscape gardener to be employed.

Once the garden has been established, the owner will need to continue with cultivation and maintenance. A plan for these activities, scheduled by month or season of the year, should be provided.

This project can develop numeracy skills in: time planning, determining quantities by calculations involving shape and space, estimation of the costs of materials and labour, as well as problem solving and use of Information Technology systems. Additionally, students can demonstrate creativity and increase their knowledge of horticulture in an interesting and realistic scenario.

House rewire

Activity planning projects need not be imaginary scenarios. In the next example, we look at the planning carried out by a student for the actual rewiring of a three-bedroomed bungalow.

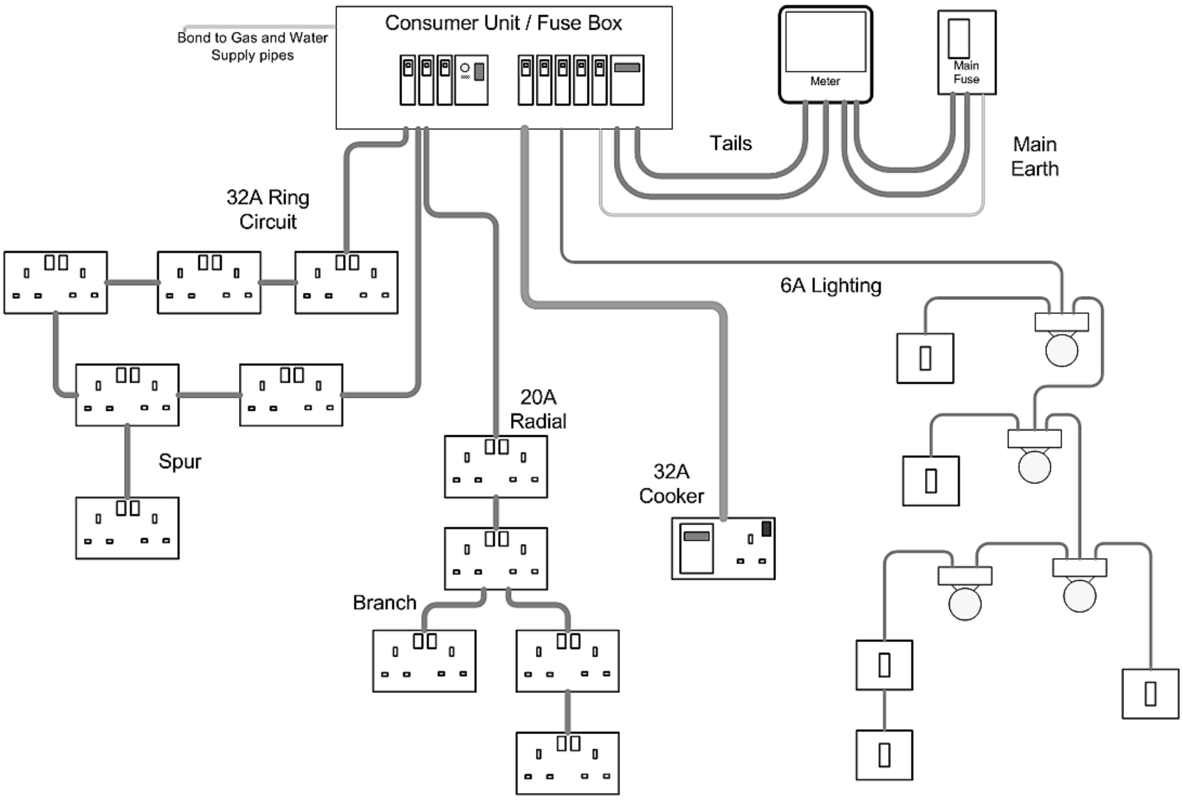
Figure 69: Bungalow where wiring installation is planned

Work was carried out to completely renovate the bungalow, requiring extensive work both internally and externally. The original bungalow built in 1980 is of concrete block and brick cavity wall construction. The renovation work involved: removing and renewing the external render, adding an en suite bathroom, remodelling the kitchen, removing all the existing internal services, rewiring, renewing the heating and hot water system, replacing the septic tank, then re-landscaping the garden. The total works were estimated to take approximately 14 months to complete.

The objective of the planning was to determine the sequence of work required, to schedule this work, and calculate the time required to complete the rewiring. Critical Path analysis was used in this process.

The layout of a typical house wiring system is shown below in figure 70. The main features are:

- Live and neutral cable tails are taken from the electricity meter to the consumer unit and fuse box. The earth connection from the consumer unit is bonded to incoming metal services such as water pipes.
- Power sockets are generally connected in a ring circuit, although radial power connections may also be used. High load appliances such as a cooker or shower heater may have their own dedicated power cables.
- Lighting will be connected in a separate circuit.



wiki.diyfaq.org.uk/index.php/House_Wiring_for_Beginners

Figure 70: Typical house wiring diagram

House wiring can require extensive building work, to allow the installation of cables in walls, floors and ceiling spaces, and to make good the surfaces after installation is completed. The tasks identified for the bungalow rewiring were:

- Sinking boxes into walls for installation of power sockets
- Chasing channels into walls to accommodate the wiring
- Running the cabling
- Protecting the installed cables and making good the walls
- Installing the consumer unit and fuse board
- Fitting all electrical accessories
- Earthing and earth bonding
- Testing and certification of the completed installation.

The time required to complete each of these tasks was estimated, based on two electricians working for a normal period of eight hours a day. Some tasks have to take priority, but some tasks may be carried out at the same time.

	Activity	Immediate Predecessor	Planned Duration (days)
A	Sink all outlet back boxes		3
B	Sink all lighting switch back boxes		4
C	chase walls for wiring	A,B	5
D	Run all cabeling	B	2
E	Capping	C,D	1
F	Consumers unit	E	1
G	Accessories	E	4
H	Earth bonding	F,G	1
I	Testing, certification & commissioning	H	2

Figure 71: Sequence of wiring tasks

A Gantt chart was created to show the earliest starting dates and durations of each of the sequence of operations.

Critical Path

House Rewire - Gant Chart

	Task Name	Start Date	End Date	Duration	Pred
	First fix	**07/02/12**	**20/02/12**	**10**	
A	Sink all socket outlet back box	07/02/12	09/02/12	3	
B	Sink all lighting switch back box	07/02/12	10/02/12	4	
C	Chase walls for wiring	13/02/12	17/02/12	5	3
D	Run all cabelling	16/02/12	17/02/12	2	
E	Capping	20/02/12	20/02/12	1	
	Second fix	**21/02/12**	**29/02/12**	**7**	
F	Consumers unit	21/02/12	21/02/12	1	
G	Accessories	21/02/12	24/02/12	4	
H	Earth bonding	27/02/12	27/02/12	1	
I	Test, certificate & commission	28/02/12	29/02/12	2	10

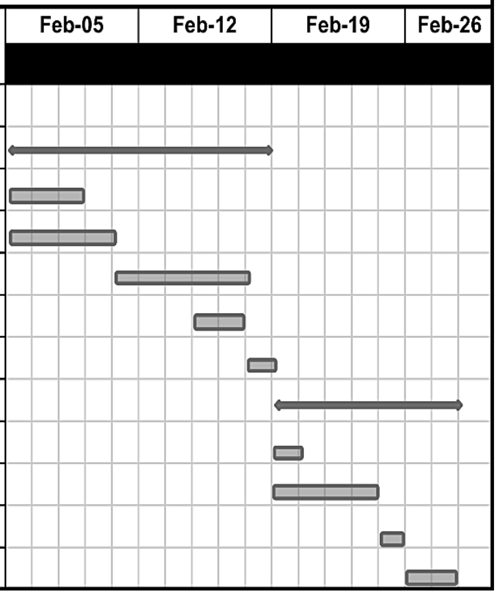
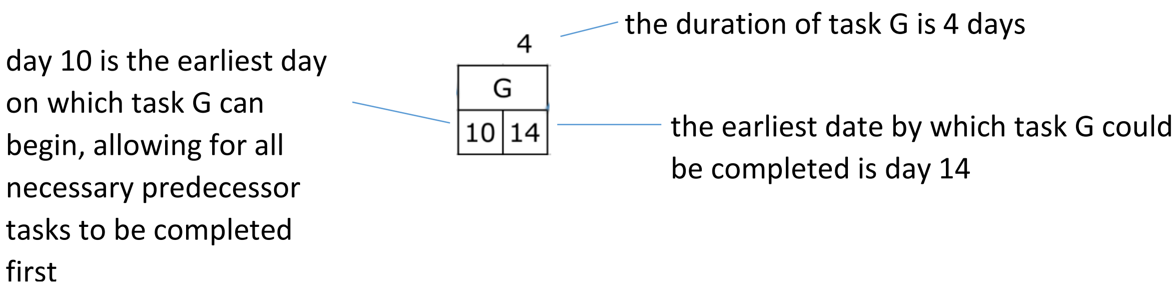


Figure 72: Gantt chart for the sequence of wiring tasks

Critical path analysis could then be carried out. A critical path diagram is shown below in figure 73. Nodes are included for each operation, and show information about the scheduling of the task. Taking task G as an example:



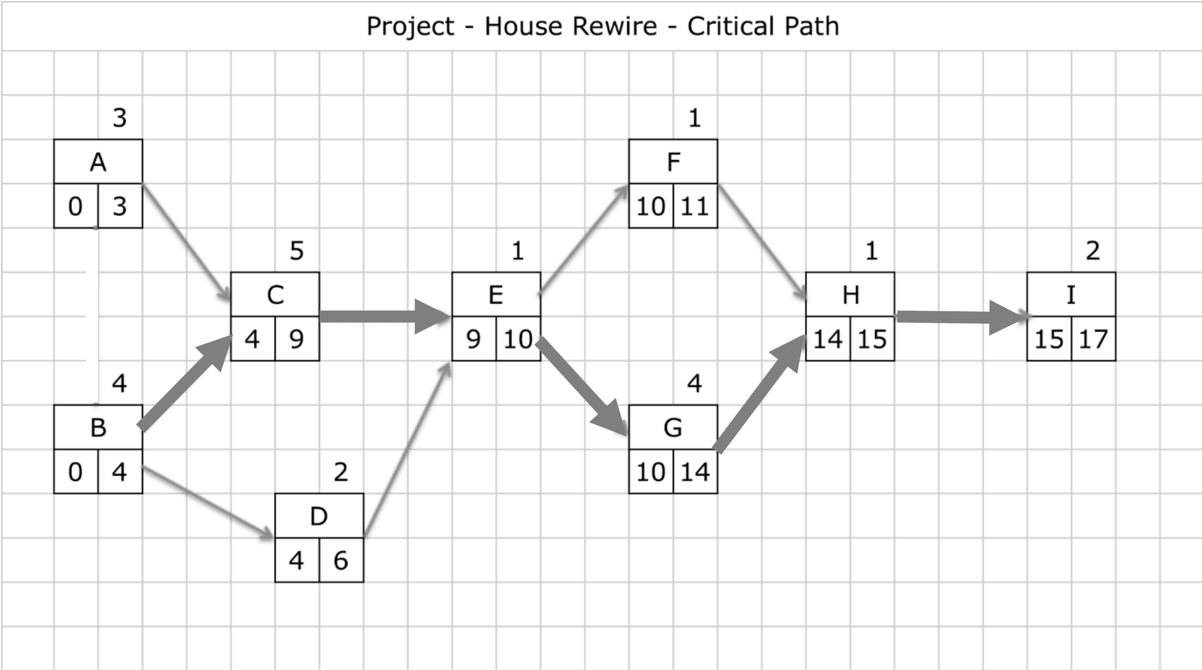


Figure 73: Critical path diagram for the sequence of wiring tasks

Tasks are linked by arrows in the critical path diagram to indicate the sequence in which work must be carried out. For example, task C cannot begin until A and B are completed. Since A takes 3 days and B takes 4 days, the earliest time that C could begin is on day 4.

The critical path is indicated by bold arrows. If any task on this path is delayed, then the project overall will be delayed by an equivalent amount. For example, if task C begins on day 4 and takes the expected time of 5 days, then task E can begin immediately afterwards on day 9. If, however, task C is delayed by an extra day and is not completed until day 10, then this will delay the start of task E by one day also.

For tasks not on the critical path, then some delay is possible without affecting the overall schedule for the project. For example, if all goes to plan then task D will be completed on day 6. It would be possible, however, for task D to over-run by up to 3 days and still be completed by day 9 when task E is scheduled to begin. The extra 3 days allowable for task D is known as the **float time**.

Critical path analysis is of value, as it helps identify the tasks which are the most important to the overall completion of the project on schedule. If tasks on the critical path are seen to be delayed, it would be sensible to transfer resources to these tasks from parallel activities where float time is available.

The Three Peaks Yacht Race

In our final example of activity planning, we look at a complex task that might be given to students undertaking a course in coastal navigation for sailors.

Each year, the Three Peaks Yacht Race departs from Barmouth. Boat crews sail up the west coast of Britain, putting in to port at Caernarfon and Whitehaven, and ending at Fort William. The sailing boats carry teams of athletes who go ashore at these ports to cycle and run to the summits of Snowdon, Scafell Pike and Ben Nevis.

Navigation students are given the challenge of planning the sailing stages of the race.

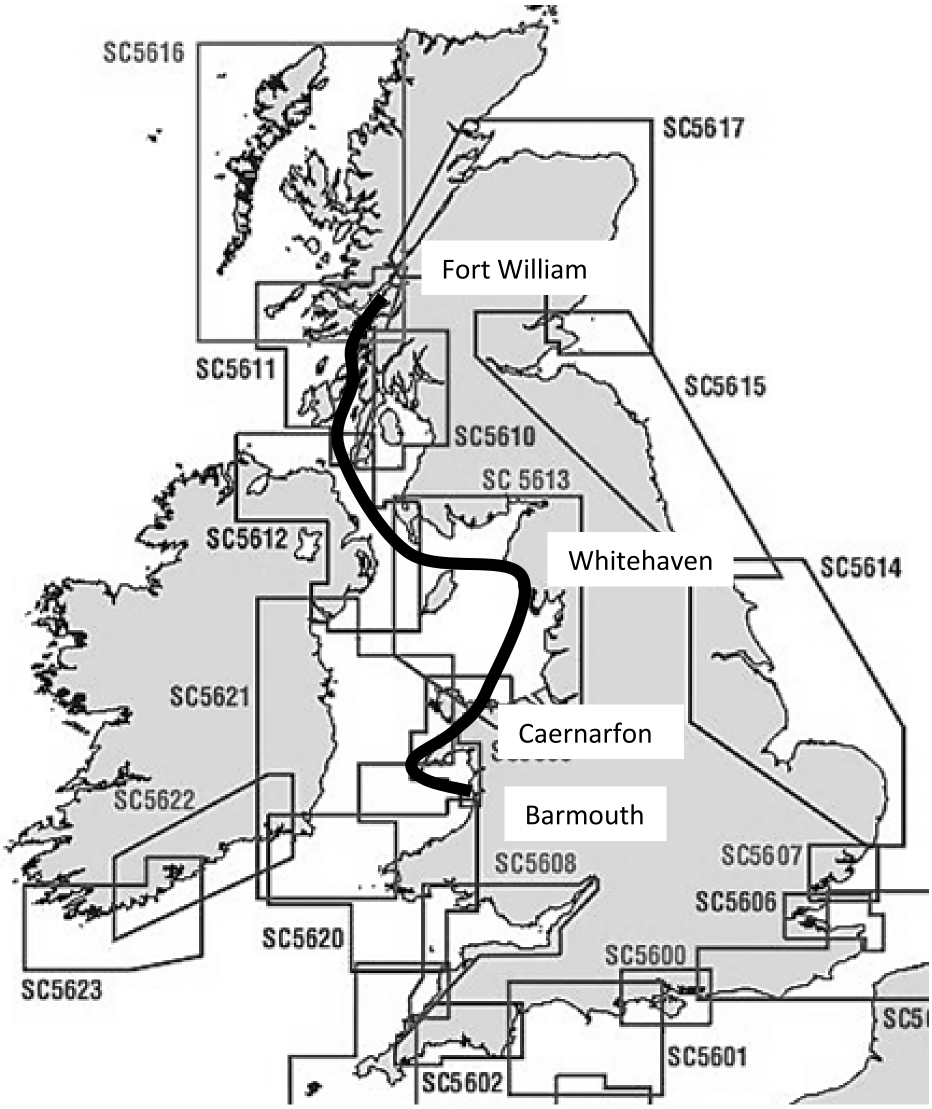


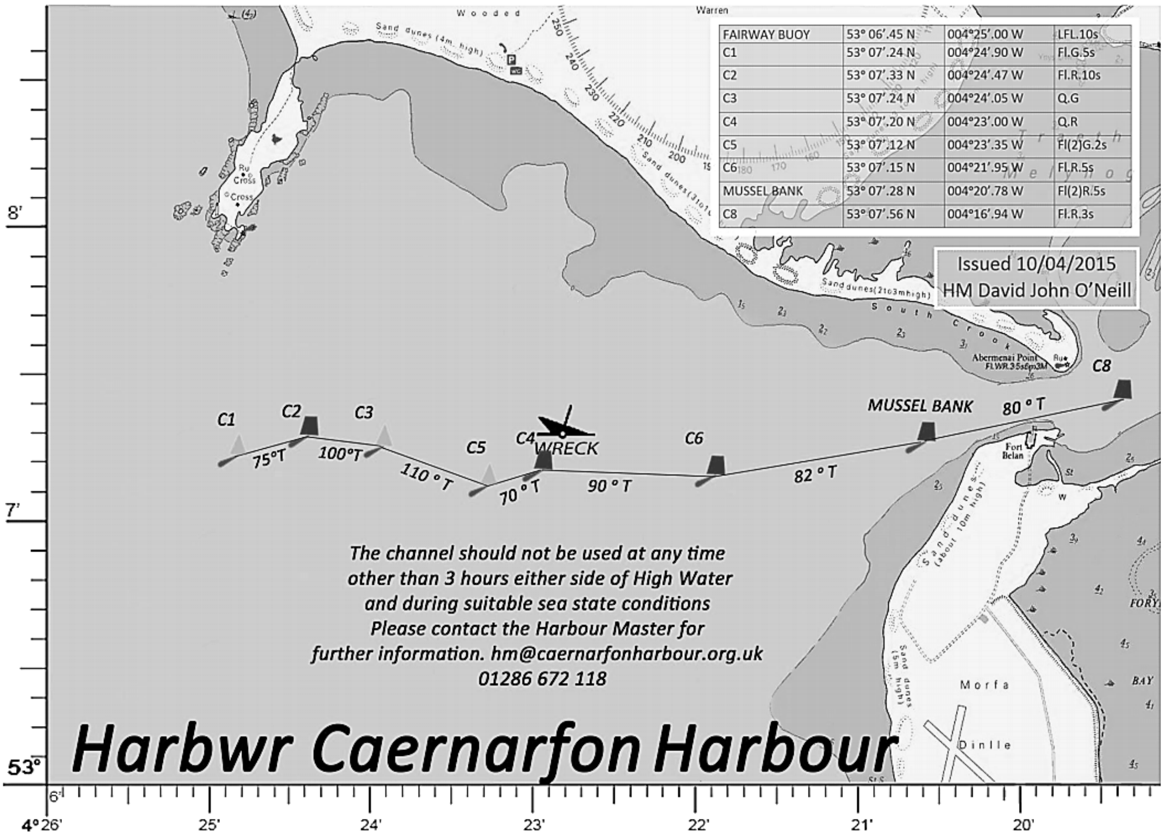
Figure 74: Marine charts covering the route of the Three Peaks Yacht Race

Students are provided with marine charts covering the route, plus more detailed charts of harbour approaches and tidal channels along the route.

Use of engines is not allowed during the race, so charts of wind speed and direction will be of value in planning the sailing routes.

The first leg starts from Barmouth. Yachts sail approximately 62 sea miles, past Bardsey Island and the Lleyn Peninsula, over Caernarfon Bar and into Caernarfon. Runners then set off to the summit of Snowdon.

Harbour buoyage information will be provided for the approach to the Menai Straight and Caernarfon harbour.



www.caernarfonharbour.org.uk/note_e.htm

Figure 75: Navigation channel at the entry to the Menai Straights

Tide tables will be available for the area of Anglesey and the Menai Straights for planning the next stage of the voyage.

The amount of time taken for the ascent of Snowdon and return of the runners will be specified.

Nearby Tide Station HOLYHEAD
Distance from center: 50 km
Weekly High / Low Tide Table

Date	Day	Time	Height
06/23	Thu	05:55 AM	90L cm
06/23	Thu	12:07 PM	520H cm
06/23	Thu	06:09 PM	110L cm
06/24	Fri	12:24 AM	550H cm
06/24	Fri	06:35 AM	90L cm
06/24	Fri	12:49 PM	510H cm
06/24	Fri	06:51 PM	120L cm
06/25	Sat	01:06 AM	540H cm

Figure 76: Tide table for Holyhead

After departing from Caernarfon, crews can choose to sail around the island of Anglesey or continue, under sail only, through the Menai Straits.

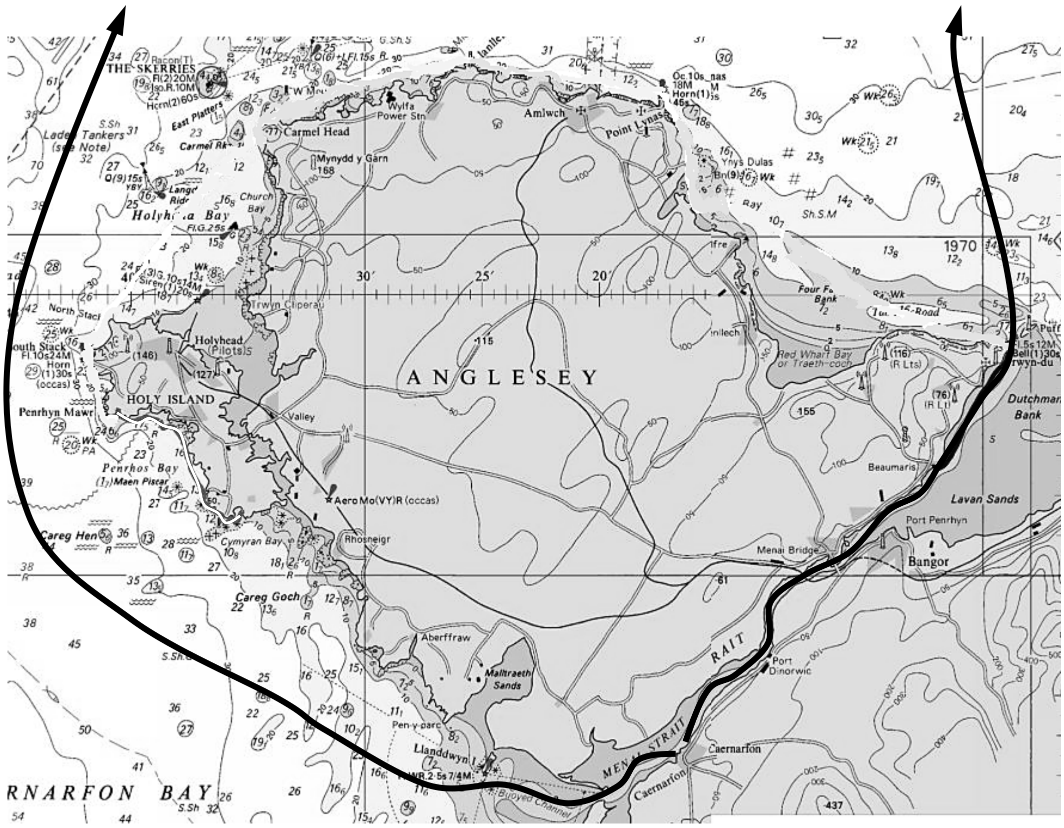
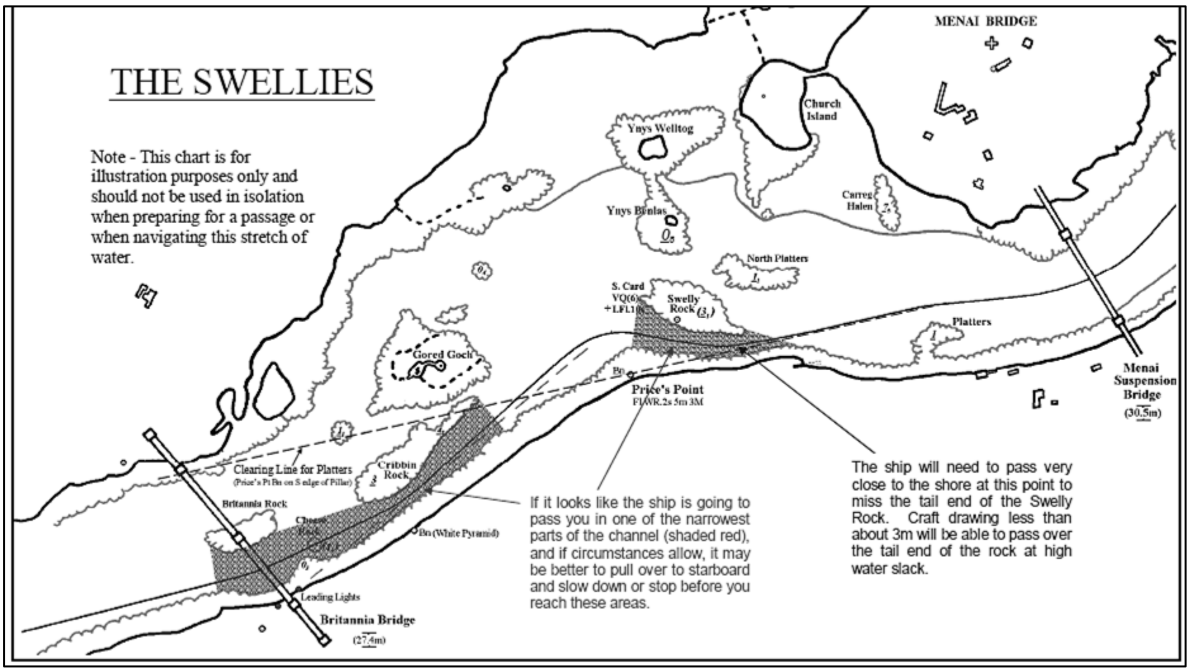


Figure 77: Alternative routes around the island of Anglesey from Caernarfon from Caernarfon

Passage through the Menai Straights is difficult at some states of the tide, but can provide a more direct route towards Whitehaven. This will be an important decision for race crews.



www.caernarfonharbour.org.uk

Figure 78: Navigation through the Menai Straights

After a further sail of approximately 100 sea miles, yachts arrive at the marina in Whitehaven. Navigation charts will be provided for the approach to Whitehaven harbour. The athletes disembark and race to the summit of Scafell Pike, cycling to the foot of the mountain and then running to the summit.

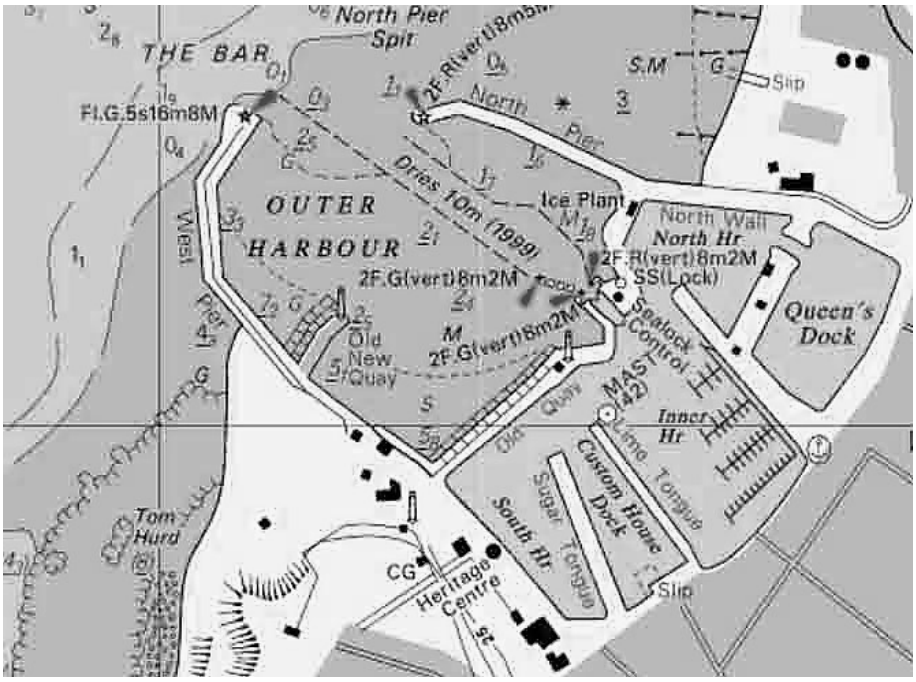


Figure 79: The approach to Whitehaven harbour

The time of return of the athletes will be specified. The race then continues by sea from Whitehaven to Fort William.

> This sailing leg is a distance of approximately 227 sea miles rounding the Mull of Kintyre and into the Sound of Jura, through some of the most beautiful scenery but with many tidal gates to negotiate. The race finishes just north of Fort William at Corpach, the entrance to the Caledonian canal where the sailing is over and skippers can lock in to Corpach Basin and lie alongside.
>
> www.threepeaksyachtrace.co.uk

This final stage of the sailing course is particularly challenging, as a number of alternative courses are possible between and around the inner islands of the Scottish coast. For example, skippers may choose to pass between the islands of Jura and Islay through a narrow and shallow channel, or take a similarly difficult course through the Sound of Jura (figure 80).

Apart from tidal information, students will need to consider wind speeds and directions which will be provided in meteorological charts (figure 81).

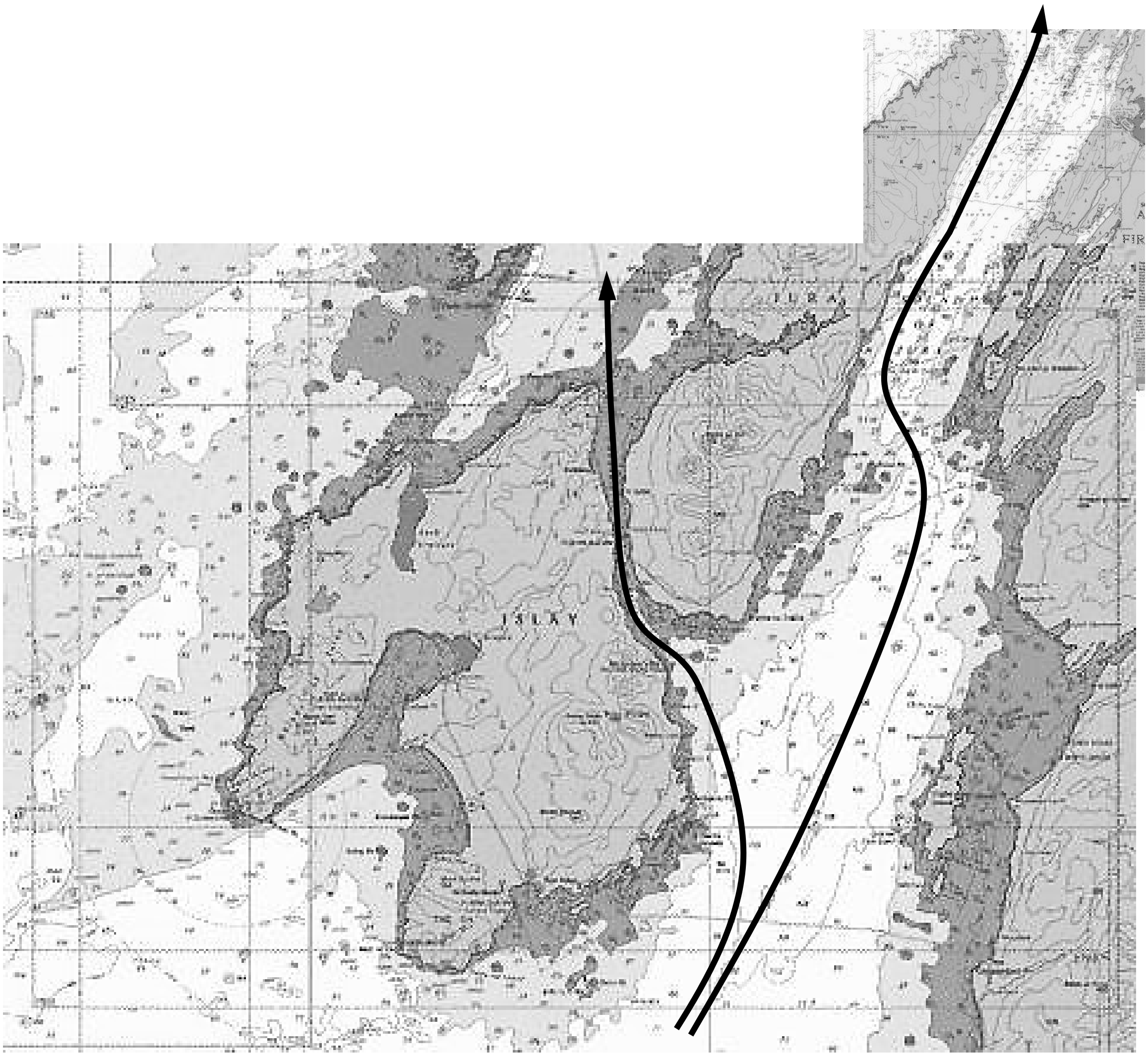


Figure 80: Navigation routes around the Isle of Jura

At the end of the planning exercise, students will present their chosen route for the sailing stages of the race. Decisions should be justified by referring to tide and meteorological information. An important aspect of the planning is to consider alternative strategies in the event of changes in weather conditions, or unexpected problems causing delays to the planned schedule.

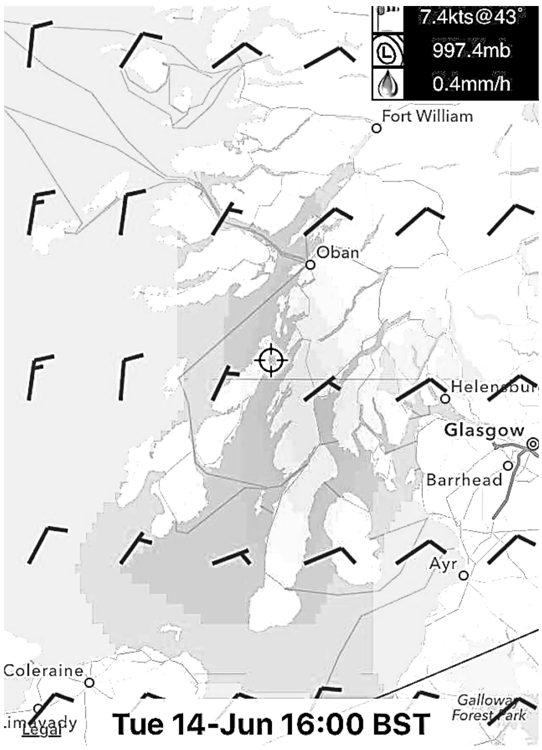


Figure 81: Meteorological chart indicating wind speed and direction