1 Layout Design

1.1 Introduction

Much frustration and wasted effort can be avoided by considering and defining the objectives of your layout carefully at the outset. This stage will be simple if the desired layout is to be similar to one with which you are already familiar, but, if only a vision, much care will be required; visions are difficult to pin down. Beware of those who say "just let it grow". They have probably already built several layouts and, at least in their later projects, had a reasonably clear perception of their objectives and the limitations within which they would have to work. The preliminary phase should be enjoyable. Make the most of it – it will be time well spent.

1.2 Layout Basics

"What are your interests, what do you want to achieve?"

Before making plans, be clear about the following basic points.

Space

- Location:
  Outdoors, in a loft, in a basement, in a shed, in a living-, spare-, or bedroom?
  Is access easy, or only for the athletic?
  How much space is there, how wide, how long, how much headroom?
- Lighting:
  If indoors or in a shed, ensure the best lighting that you can. Make the most of natural lighting; you will spend a lot of time in and around the railway.
- Access:
  If it is intended to take the layout to exhibitions or moving house is probable, ensure that access allows you to remove the line in well considered sections.
- Temperature and Humidity:
  What are their ranges? Without special treatment, a loft gets hot in summer and cold in winter; a basement stays much nearer to one level but may be damp. If outdoors in a shed make sure that heating is adequate for the worst of the winter. The more stable the conditions, the less likely is it that baseboards will distort and deform.

Ownership

Is the line:
To be built purely for your own use?
To be built by you but worked by a group?
To belong to a group or club?

If it is to be operated by a regular team, consult them about its main features and scope. The happier they are with these, the easier it will be to achieve a purposeful team.

If owned by a club, are the plans generally acceptable, especially to those who will do the most work on the project?

Budget

- Money
  How much can you afford, per month, per year? Is there any overall limit on cash?
- Skills
  What can you draw on, will you need help with joinery work, point work, wiring and electrics; will such help need to paid for?
- Time
  How much can be allocated to the project, per week, per month, per year? Does the line have to be in a runable or exhibitable state by a given date? Aim to start running on sections as early as possible, both to encourage the builders, and to reveal faults while they are easily rectified. Is there an overall time limit on the life of the project?
- Rolling Stock
  How will the line be equipped, especially with rolling stock? Will there be Group-owned stock? Does this have to be bought early on or can its purchase be deferred until the basic layout is up and running? Settle standards at the outset; these include, limiting dimensions, types of coupling, control systems, historical period, and even quality of modelling.

Portability:

Is the layout intended for frequent moves to shows, occasional moves to a new site, or to be indefinitely permanent?

If the line is to be taken to shows, how will it be transported? If by car the modules will generally have to be small. If by lorry or large van, quite large ones can be considered. Make sure that these modules are light enough to be carried by members of the group. Heavy modules are more vulnerable to damage, but light ones must be sufficiently rigid to withstand the shocks of transportation.

If moves are likely to be rare, the largest feasible modules should be aimed at but the size of these will be limited by egress and access routes and by the transport available. Even mobile cranes through removed windows have on occasion been used. Such modules must either be strong

enough to be lifted as they are, or adequately strengthened for the move.

Even a permanent layout should be designed so that dismantling involves the least damage to track and baseboards. If track can be lifted without distortion it has re-sale value and layouts can find new homes if not too much hacked about. Remember that the Guild has an Executor and Trustee service. An appropriate clause inserted in your will could prevent the whole of your life's work ending in a skip.

Setting

What kind of running do you want from the layout? Is it primarily for testing locos and rolling stock, for the display of trains in motion, or for fully developed prototypical operation. What is the basic time period to be represented by the line and the stock on it? Is it to be in an urban, an industrial, a rural, or an exotic setting?

When the plans of the layout are becoming firm, mock-ups of the projected line can be of great value; ideas sketched two-dimensionally on paper may fail to reveal inherent problems. Mock-ups are fun to make and easily modified, helping you to get things of the right size in the right place. They also help you to plan the lighting, especially for an exhibition layout.

Modelling a stretch of prototype railway exactly to scale is rarely possible and seldom desirable; artistic compression is usually needed. A mock-up allows the most to be made of the principal viewing points.

Track, buildings, structures, rolling stock should all be of uniform standard if the illusion of reality is to be achieved. Reflect again on the skills available for the project. Will they all be in balance?

Operation and Maintenance

How are the movements of trains to be observed and controlled, how will uncoupling and coupling be performed, and where will these actions be needed? Are you intending to use some form of auto-coupler? If so, how will it be installed and where will its controls be situated.

Where may maintenance be needed? Is access adequate to deal with derailments and repair on hidden tracks and turnouts, wiring, and point machines? Think of these jobs having to be performed while exhibiting, make them as easy as possible (e.g. replacement of point machines).

Can you see the train at all parts of the layout? TV monitors allow hidden stretches of line to be observed. Walk-about controllers, whether on a long lead or capable of being plugged in where needed, allow stock to be placed exactly over uncouplers or uncoupled readily by hand.

Consider also the use of less common methods of control. Radio control, the wire-less railway, brings a new dimension to operation in the garden; track cleaning ceases to be a time-consuming chore, being only the removal of twigs and large leaves. Digital Command Control (DCC) does need reasonably clean track, but greatly reduces the amount of wiring and sectioning required.

1.3 Layout Types

There are three main types of layout, the Oval, the End-to-End, and the Out-and-Back. (See Figure 1-1) All others are combinations of these. None-the-less great variety can be achieved with these elements. Examples are noted below with their salient characteristics. The terminology and features in use generally in the modelling world are also introduced. These can have specific connotations relevant to operation and electrical connections.

Categories

- Main Line / Junction These configurations can be very complex. May be designed for end-to-end or continuous running. Can involve many builders and operators, a good project for a club or group.
- Branch Line Ranges from basic, with limited operational interest, to quite extensive. Good scenic features are needed to interest spectators.
- Loop to Loop or Dogbone* The dogbone is an artifice to give main line double track over much of the layout. The loops may be hidden under hills. It allows continuous running, and is typical of display layouts.
- Oval, single or double track. The basic Test Track, offering continuous running. It can be elaborated with loops and spurs to termini, or developed by superimposing one circuit on another, linked by gradients, to become a doubled over figure of eight.
- Oval with Return Loop and Terminus* The return loop allows a train to leave the terminus, run for the required number of circuits and return.
- Point to Loop, or Out-and-Back* This configuration allows departure from a terminal and return direct to the terminal. A variant is to introduce a triangular junction to allow running round the loop before returning to the terminal.

* Because these configurations involve return running on the same track, this introduces wiring complexities which are addressed in Part 8 Section 6 'Return Track and Triangular

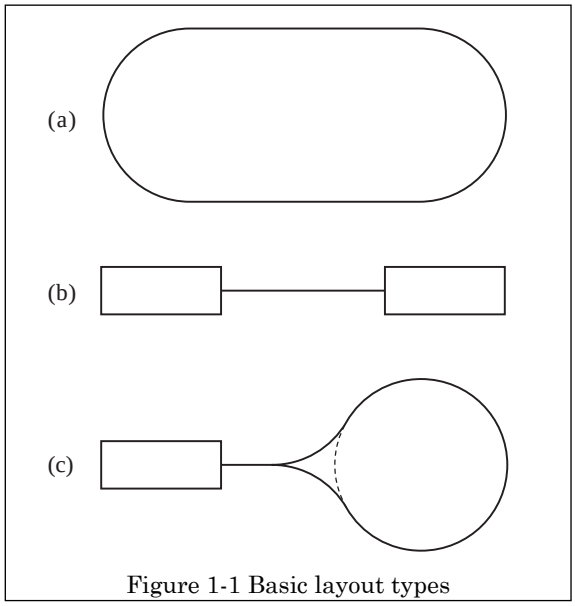

Figure 1-1 Basic layout types

Junction Wiring'.

Features

- Fiddleyards; Traversers; Sector plates; Cassettes These devices allow complete trains or coupled stock to be stored so that they can be run on to the layout with minimal handling of the stock. They have been listed in descending order of their demand for space.
- Passing Loops Necessary if two or more trains are to be run on the same track.
- Sidings Essential to the shunting, storage and marshalling of trains, both goods and passenger.
- Headshunts Allows trains to be shunted without fouling the main line.
- Turntable Necessary once the basic branchline has started to grow. It is part of a loco yard, associated with shed, coaling stage, watertanks, pits. A loco depot needs considerable space.
- Spirals Raises trains from one part of the layout to another; may be entirely hidden or with visible sections as attractive features.

1.4 Layout Specification

This is the 'sketch' phase of layout design, the transition from the wish list of the 'grand design', to a detailed design for a track layout proved to be feasible. It is an iterative process in which practical problems may force you to reconsider how much of the grand design is achievable. Each feature needs to be examined to see whether it contributes adequately to the whole and can be modelled effectively. At worst a scaling down of the whole project may be needed. Points which need consideration are covered in the following sections.

1.4.1 Portable/exhibition layouts

Just what type of baseboard will be built, and what is its construction method? This is of great importance for the track layout design, as pointwork must be kept clear of baseboard joints. Of equal importance is the size and weight of the sections to be carried into an exhibition hall. This can also be affected by the type of vehicle available for transport to and from the exhibition. Is it practicable to pair separate sections during transit, using boards bolted across each end and exposing the underside of each section, so that the fragile upper faces with scenery and track protect one another.

Is all the track on one level or are there stretches of superimposed or low level track? In O gauge, this deepens the layout considerably and calls for careful design of the affected sections of the baseboard, with due allowance for access to low level tracks. Such schemes should receive early attention; they cannot readily be added to existing layouts.

What method will be used for joining of the baseboards, physically and electrically? This is important for ease of access, reliability, maintenance, and for locating buildings or scenery to conceal those joints.

How high will structures and scenery be? Are they liable to be damaged in transit; should they be left in situ and protected in some way? This may affect baseboard design, or they may be detached and packed separately.

Just how will lighting objectives be met? Are the fittings to be built into the baseboard structure, or on a separate gantry. If the latter, how is this going to be erected and taken down without damage to self, the lights or the layout? Think about likely safety or heating hazards – consider operating for hours under an array of 60 watt bulbs!

1.4.2 General for all layouts

Will the electrical system be cab control, zone control, walk-about, radio, DCC, or some combination of these? The choice of a particular type of operation may force a specific electrical approach that may affect the track layout.

What access needs to be allowed during construction or for fault rectification? Will the operators have to be limbo dancers to reach controllers and couplings? Does it take account of the increasing age of the operators?

Imagine leaning across the layout to couple locos or stock. Is this likely to demolish some building or scenery? You may need to create access which itself could affect your ideas on the layout.

1.5 Layout Design

1.5.1 Space available

When turning dreams into reality care in design is needed if trouble is to be avoided. Measure the space to be occupied and sketch the outline as accurately as possible. To make the task easier, the initial drawing can be produced on graph paper. On the plan of a permanent layout, show any obstructions that occur, e.g. roof braces, boiler flues, pipes, cables, access ladders in a loft or positions of doors, windows, powerpoints, in the layout room. Be particularly careful to allow for the inward slope of the roof in lofts and attics; this feature will determine the general height of the track and the usable space.

In the case of a layout assembled from a series of modules and which may be seen in its entirety only at an exhibition, the design in its complete form must still be drawn out before the track plan can be superimposed on it.

1.5.2 Selective compression

The space required to represent a prototype layout exactly to scale will almost certainly be greater than that available for the model. On the prototype, a ten chain (200m) curve is tight and requires checkrails. On an O gauge model this would have a radius of 4.6m (15ft). A suburban platform can be 137m (450ft) long and accommodate a locomotive and five 18m (60ft) coaches. In O gauge terms this becomes 3.15m (10ft 4in). Similarly, the platform of a light railway halt can be 61m (200ft) or 1.4m (4ft 5in) in 7mm scale. Once sidings and other pointwork are added to the scene the length increases considerably. As an example the typical terminus used to illustrate signalling in Part 6, Section 2, if measured from the inner home signal to the end of the platform, would probably be some 305m (1000ft). In O gauge this would occupy 7m (23ft).

Many layout builders would find this amount of space unobtainable. The radii of model turnouts are, however, usually tighter when compared to the prototype and this helps to shorten the overall length of the trackwork. If the number of coaches is reduced and hauled by a smaller locomotive so as to require a shorter platform face to accommodate them, the overall length of the station layout could be decreased by between one third to one half. In the example just quoted, a length reduced to 183m (600ft) would become 4.2m (13ft 9in) in O gauge, which would fit along the wall of the average garage. By reducing the size of the station buildings to match the reduction in platform length the overall effect could be acceptable.

If a fiddle yard were added to the terminus, the overall layout length would be approximately half as much again, i.e. about 6.5m (21ft). Where space is at a premium, consider leading the main line 'off stage' part way along the layout, allowing the yard to be concealed behind the scenery.

Stations with long platforms may be suggested by showing only the outer ends of these, a bridge can cover what then can also be the fiddle yard.

1.5.3 Rolling stock requirements

Table 1 in Part 2, Section 1, Plain Track, gives recommended minimum radii for various groups of rolling stock, tighter curves are possible but require some compromises with couplings, buffing gear, sideplay in coupled wheels, and probably gauge widening. This is not a field to be recommended for the beginner.

If the area available for the layout permits, easier curves will not only make train movements that much easier but also add to the appearance of the track. This table also specifies, within limits, the type and general dimensions of the rolling stock appropriate to the various groupings.

Using this information, determine at the outset the minimum radius both for mainline curves and for yards and spurs. The running lines should be able to take the largest projected locomotive, carriage sidings the longest coaches without buffers locking, goods spurs shunting locos and an adequate number of wagons. Though generally this should mean mainline curves of 1830mm (6ft) radius, a careful builder in O Fine standard can usually contrive to get even the longest loco round 1370mm (4ft 6in) and some even contrive to get big locos round 910mm (3ft). However, big locomotives on sharp curves are not pretty; the minimum curve on prototype lines is about 160m (8 chains) which, in O gauge, becomes 3660mm (12ft). Do try to use the largest radii that can be accommodated and enter the sharp ones with a transition (see Part 2, Section 1.2). Good use of transition curves will enhance both the running and appearance of the layout. Curves on industrial spurs on the prototype were much sharper, down to 20m (1 chain), giving an O gauge equivalent of 460mm (1ft 6in).

When designing a station or yard, some dimensions need to be decided at the outset. What will be the length of the longest train that can be handled effectively on the layout? Some typical model train lengths suited to the various groups are shown in Table 1 below. (Group 1, trams, has been omitted).

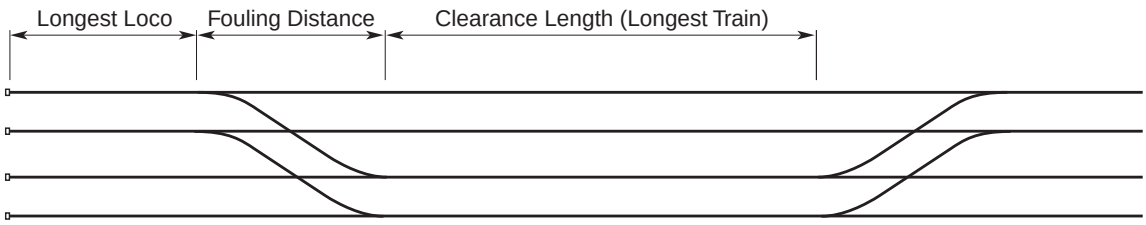

Figure 1-2 Run round loop length

Table 1 Some Typical Model Train lengths

Group	Locomotive	Rolling Stock	Overall Length	Model Length
2	0-4-0T Dock Tank 5.5m (18ft)	4 x 5.5m(18ft) wagons + 7.6m(25ft) brake	35m (115ft)	805mm (2ft 8in)
3	0-6-0T 7.6m (25ft)	4 x 6.1m(20ft) wagons + 7.6m(25ft) brake	40m (130ft)	910mm (3ft)
	0-6-0 16m (52ft)	3 x 11m(36ft) 4wheel coaches	49m (160ft)	1120mm (3ft 8in)
4	0-6-2T 11.3m (37ft)	6 x 6.1m(20ft) wagons + 8.2m(27ft) brake	56m (184ft)	1288mm (4ft 3in)
	2-6-0 18m (59ft)	3 x 17m(56ft) coaches	69m (227ft)	1589mm (5ft 2in)
5	2-6-4T 13.4m (44ft)	7 x 6.1m(20ft) wagons + 8.2m(27ft) brake	70m (231ft)	1617mm (5ft 4in)
	4-6-0 18.9m (62ft)	3 x 19.2m(63ft) coaches	77m (251ft)	1757mm (5ft 9in)
5(MI)	Cl 47 19.2m (63ft)	5 car container set	122m (400ft)	2800mm (9ft 2in)
	DMU	3 car set	55m (180ft)	1260mm (4ft 2in)

1.5.4 Run round loops

How long is the largest locomotive and the longest train that will operate on the layout? This length must be provided at a passenger platform, between clearances, where tracks run parallel (see Figure 1-2). In a goods yard it may be possible to split a train and handle it a section at a time. What is the minimum radius that will be used? When designing pointwork, use a radius greater than the chosen minimum curvature otherwise, wherever shunting may take place, there is a risk of bufferlocking. Using a larger than minimum radius gives a tolerance for inaccuracies in construction of track and vehicles. Never, in such locations, install a reverse curve without a short transition straight.

1.5.5 Continuous running

When a layout has to provide for continuous running then space must be available, at the very least, to accommodate a simple circle. One or more

Table 2 Typical run-round loop lengths based on the train lengths from Table 1
The overall length is equal to 2 x Loco length + 2 x Fouling distance + total length of the rolling stock.
See Figure 1-2

Group	Model Loco	Rolling Stock	F.D.	Overall length	
2	0-4-0T 126mm (5in)	Goods train	679mm (2ft 3in)	422mm (16in)	1775mm (5ft 8in)
3	0-6-0T 175mm (7in)	Goods Train	749mm (2ft 5½in)	483mm (19in)	2065mm (6ft 9½in)
	0-6-0 364mm (14½in)	Pass. Train	756mm (2ft 6in)		2450mm (8ft 1in)
4	2-6-0 413mm (16½in)	Pass. Train	1176mm (3ft 10in)	542mm (21½in)	3086mm (10ft 2in)
5	4-6-0 434mm (17in)	Pass. Train	1323mm (4ft 4in)	592mm (23in)	3375mm (11ft)
5(MI)	Cl 47 441mm (17½in)	Container set	2286mm (7ft 6in)	592mm (23in)	4343mm (14ft 3in)

passing loops will be most desirable, especially if the layout belongs to a group. A double oval with connecting crossovers and several loops on each circuit should be provided where the group meets regularly and has several members.

The space needed for any layout of this type can readily be assessed by dividing the layout plan into squares. This approach was introduced by the American layout designer John Armstrong. The method can also be used to see how much can be got into a given space.

Briefly, a square is the space occupied by a 90º double-track curve where the centerline of the inner track is the minimum radius employed on the layout. The length of each side of the square is equal to the minimum radius plus twice the distance between track centres (see Figure 1-3). Some typical square sizes, based on the recommended minimum radii, are shown in Table 3. Note that the distances between track centres of the sharper radii have been increased to allow for vehicle overhang on curves. (See Part 2, Section 1.3).

Obviously the use of these squares is not confined to 90º bends but can also be used for partial bends and for planning reverse curves. Space for transition curves can be introduced by separating and offsetting the squares. The subject of transition curves is covered in detail in Part 2 Section 1.2.

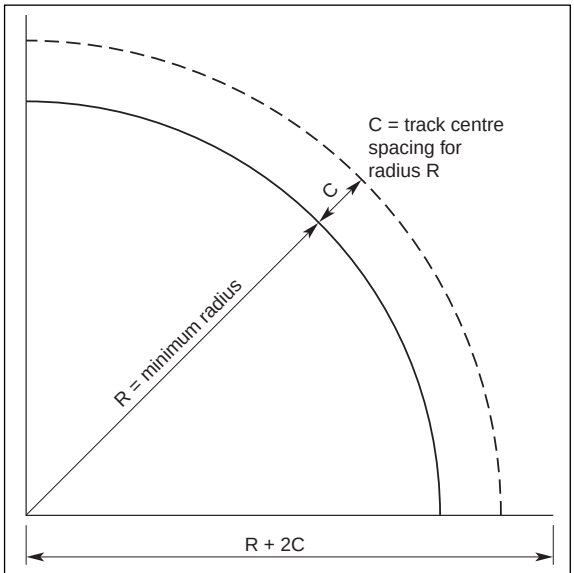

Figure 1-3 John Armstrong's layout squares

1.5.6 Minimum size oval for continuous running

The actual size of oval suitable for continuous running depends on a number of factors; the length of trains; the length occupied by the station area if it is accommodated on one of the straight sides; etc. A reasonable estimate can be made, using the information given above, to calculate the minimum area required to accommodate typical trains, as described for each group. From that estimate it will be apparent whether the layout can be fitted into the space available. Simply, the space would need to be two squares wide by two squares plus the run-round distance long. Shortening the run-round length by having the loco run on to the curve, etc., can help squeeze the overall length but could produce problems with coupling and uncoupling, particularly with the smaller radii. Table 4 gives some guide sizes. (Group 1, Trams, have not been included.)

1.5.7 Turnouts

These are the primary building blocks in any layout. The space which that layout occupies depends to a great extent on the type of turnout used, likewise its character. There are four options

Table 3 Typical Square Sizes

Group	Recommended Minimum Radius (R)	Track Centres (C)	Square size (S = R + 2C)
2	600mm (2ft)	100mm (4in)	800mm (2ft 8in)
3	915mm (3ft)	90mm (3½in)	1095mm (3ft 7in)
4	1220mm (4ft)	90mm (3½in)	1380mm (4ft 7in)
5	1800mm (6ft)	80mm (3⅛in)	1960mm (6ft 6in)

Table 4 Minimum oval sizes

Group	Square size	Run-round loop	Area required
2	800mm (2ft 8in)	1775mm (5ft 8in)	1600mm (5ft 4in) x 3375mm (11ft)
3	1095mm (3ft 7in)	2450mm (8ft 1in)	2190mm (7ft 2in) x 4640mm (15ft 3in)
4	1380mm (4ft 7in)	3086mm (10ft 2in)	2760mm (9ft 2in) x 5846mm (19ft 4in)
5	1960mm (6ft 6in)	3375mm (11ft)	3920mm (13ft) x 7295mm (24ft)

to consider. (see also 1.5.13, page 7-1-11)

a) Ready-made Turnouts.

b) Ready-made Components, e.g. switches and crossings.

c) Components made from plain rail on existing Standard Drawings.

d) Components specifically tailored to the design of the layout.

A layout using Option a) is most easily designed full size on the baseboards as the manufacturers can usually supply full size plan-sheets or drawings. The preliminary design, done on paper to reduced scale, will probably need modification when redrawn full size on the actual baseboards. While it may be supposed that the manufacturers have ensured accuracy by assembling their turnouts in jigs, there can still be problems with them if there are bumps in the baseboard and kinks in the plain track linking them together.

A layout using Option b) is also best designed full size and hopefully the manufacturers can again supply full size drawings. If not the drawings will have to be produced with the aid of any information that can be gleaned, say from specialist groups as c) or using the information set out in Part 2, Section 2.

With Option c), the layout is easy to design and may be developed in conjunction with turnouts built to option b) wherever the components suit, as the standard drawings can be photocopied as full size drawings.

The first three options will produce workable track layouts but the results are likely to need more than the minimum of space if appearance and performance are not to suffer. This can occur on the prototype: see Photo 1.1.

If turnouts according to Option d) are used, the whole layout can be planned so that curves and crossing angles make the best use of the space available while the whole looks pleasing and authentic.

Set-track components

Many of the remarks under a) and b) above apply equally to the use of pre-built 'set-track' elements which can be bought or created and a layout designed around the use of such components. Though more compromises will have to be made in design and appearance, the layout can readily be altered, likewise if it has to be relocated, the components can be re-used, allowing a revised version to be up and running quickly. Most modellers started this way, a way which can still provide a running layout in the shortest time.

Photo 1.1 Trying to squeeze a quart into a pint pot

1.5.8 The preliminary drawing

Objective

The prime purpose of this drawing is to prove the feasibility of the first rough sketches. It must be prepared with care and be accurate. It should be good enough to reveal where problems may arise and enable the basic plan to altered to deal with them. Take plenty of time over this stage, it is repaid many times over by the absence of mistakes at the construction stage.

Equipment

The preliminary drawing should be as large as can conveniently be handled. Obtain a board of adequate size on which to prepare it. Though not essential, if this board has a pair of true edges at right angles, a Tee-square can then be used. If the surface is poor, cover it with a sheet of drawer lining paper. For the actual drawing, on which inevitable there will much rubbing out, better quality paper is most desirable. Pence spent now will save pounds later, likewise for time. A scale rule; 2H, HB, 2B pencils; erasers; compasses with extensions to 620mm (2ft); if possible, draughtsman's trammels (extendable to 1250mm, 4ft), otherwise use string pin and pencil. Drawings for the minimum radius of curves are essential, also for various larger radii. Though these can be bought, their sizes will then determine the scale used for the plan, alternatively make them from cardboard or 3mm MDF board, drawing their outline with compasses, trammels, or string pin and pencil. Cut them out carefully with scissors, a knife, or fine saw, and mark them with the radius of the centre line; their width should be the scale equivalent of 32mm. Make templates at least for the minimum radius of the layout and for 1.3 and 1.5 times that radius, the latter being needed for critical pointwork.

Larger radius curves can be drawn using draughtsman's curves, otherwise known as French Curves. As the computer has largely replaced traditional draughting equipment, you may have to search for these curves. With them, however, you can make sketches more quickly and with less thought than with refined computer software. Preliminary sketches for whole layouts can be made using these curves if suitable ones have been chosen. The type known as a Ramshorn is the most suitable.

First stages

Choose a scale which will just allow the whole layout to be drawn on the board; though it could be drawn on more than one sheet, inaccuracies will creep in at the joins and the work is slowed down. A scale of between 1/12 and 1/4 full-size gives good results. Having chosen it and the options for turnouts, draw the outline of the intended baseboard area, allowing adequate room for access. Preliminary ideas may now be sketched in lightly freehand, showing only the centre line of each track. Begin also to plan the individual baseboards. If the line is to be portable or built in sections, positions of joints in the baseboards must be considered with particular care, being placed so as to avoid crossings or the toes of switches. Wherever possible a track should cross a joint at right angles.

The critical areas of the layout should now become apparent. Here rigorous and accurate treatment is essential. Where are the sharpest curves likely to be? Check these sketches against the minimum radius template. Where are the problems? Is there too much track? Settle the position and radii of the curves in the main line first, it should then become apparent where the main features might best be placed and how much length is available for them. Settle the position of the biggest items next, probably the passenger platforms. If the station is a terminal, at the end of the platform road or wherever a run-round is required, mark off the space needed for the longest loco, this places the toes of the release turnouts. In a yard, a goods train can be split and handled a section at a time, but not a passenger train. Where shunting is to take place there will be a risk of buffer-locking, be particularly careful therefore to avoid abrupt reversals of curvature, provide transitions or, at the least, linking lengths of straight track.

Detailing

Determine the minimum track spacing that you intend to use (see Part 2, Section 1.3) When drawing out an engine release crossover or similar arrangement of turnouts (Figure 7-2), draw in the second track at this spacing, parallel to the first. Now, using a radius 30% above minimum, draw an 'S' curve between the two tracks, starting from the first pair of toes, reversing near the mid-line between the two and finishing on the other track. Check it for symmetry and a smooth junction of the two arcs. The toes of the switch blades of the release crossover are thus located. A transition straight can be inserted when the turnouts are finally detailed. If a return crossover is required, measure out the length of the longest train round which the loco has to run, staring from the toes of the turnout on the second line. From there draw in the return crossover back onto the first track as for the release. Does all this fit into the outline sketch or must a rethink take place?

Checking and revising

If all now looks well, the basis of the plan should now be settled. If not, decide where compression can be achieved. Is an engine run-round loop essential, or could the train engine be released by the station shunter? Is a yard headshunt essential? All the main features of the layout should be examined and ranked at this stage, now is the time to 'simplicate'. Is the layout to be portable and divided into sections? If so, check that the joints will NOT cut through the switch blades or be near where rails cross one another. The first is impossible and the second is asking for trouble. When laying out turnouts, always try to draw in curves of more than the minimum radius. This means that you will then have a margin to ensure that errors and compromises do not go beyond what is acceptable.

Adding in the extras

With the basic plan proved feasible and pleasing, draw in all the other major features, in decreasing order of importance. Is there really room for an engine shed? Where are the carriage sidings? Is the goods yard big enough? Where one turnout follows another, is there enough space between the crossing of one and the toes of the switches of the next? Working in this reduced scale it is enough that the second pair of toes is at least a rail gauge away from the nose of the preceding crossing. A three- or four-road tandem turnout may be an alternative. Check if there is a commercial one to suit, alternatively can you make a good job of building it. Be careful when drawing a turnout with one track curving off another in the same direction. The turnout can become very long and difficult to build and maintain, the switch blades and crossing so slender as to be impracticable. Good proportions for such turnouts require that the radius of the larger curve is at least 1.5 times

that of the smaller curve. Examples would be 0.95m/1.37m (3ft/4ft 6in), 1.22m/1.83m (4ft/6ft) and 1.83m/2.74m (6ft/9ft). At this stage you should be considering the use of a mock-up. The choice of features and their blending to make a satisfactory whole is made much easier when viewed in three dimensions, while snags easily missed on a flat sheet of paper become all too evident.

Use of computers

A computer may be used to produce layout plans and the details that are incorporated. Re-drafting is easy and 'what-if' alternatives readily assessed. Almost any drawing program can be used, but a program designed for drawing work, which can handle vectors, is better than a painting package, since lines can be manipulated more easily. On-screen drawings can be created of curves which can be copied and added to to create the required layout.

An option worth considering for its ease of use is one the programs dedicated to layout design. These can be obtained for IBM PC compatibles, and many are available as shareware, which you can try before committing yourself to purchase. The simplest programs act simply as drafting packages, but with the advantage of being able to define track shapes more easily, the most complex ones will allow you to manipulate the minimum curvature and even present three-dimensional views of how the layout will look. The Americans are the leaders in these techniques, and the current 'state-of-the-art' can be found from scanning the advertisements in their model magazines.

Note: Even if a computer is used, it is only a tool – a sketchpad with bells on. It will not design the layout for you, the principles of good layout design still apply.

1.5.9 Specification for support structure

Types of baseboards to support the track plan are described in later sections. Here personal dimensions and physical constraints are listed which need to be considered before the plan can be finalised, particularly if the layout is to be a permanent erection.

Baseboard width

How far can you reach without damaging the scenery? The recommended maximum width for a layout operated from one side is 2ft 6in and from both sides is 4ft. Can you reach into the corners on the curved sections if a derailment occurs?

Baseboard height

How tall/short are you? There are no firm recommendations here but about mid-chest height is about right to make reaching comfortable while bringing the viewpoint towards eye level. Reminder – tall layout owners may need to provide boxes for their short friends to stand on.

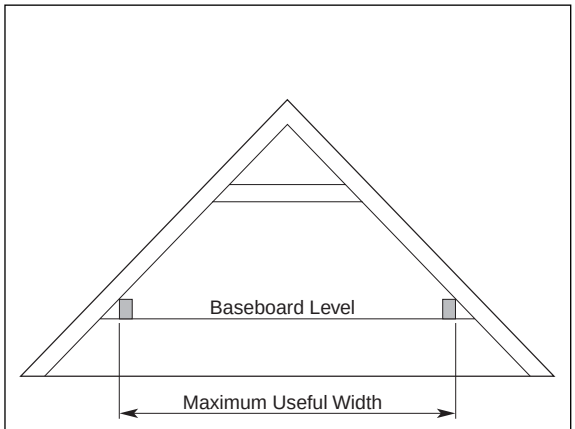

Figure 1-4 Layout space in a loft.

If the layout is intended for exhibition, the baseboard level may be higher than normal, the height being determined by the view being presented to the public. This in turn could involve providing a working platform for the operators. Conversely, if the display is aimed at children, the height may need to lower than normal and seating provided for the operators.

Aisle width

How wide are you? The average person can operate in a minimum aisle width of 535mm (1ft 9in) but if two operators have to pass one another the absolute minimum is 760mm (2ft 6in) and 900mm (3ft) is preferred to avoid brushing against the layout. Have you allowed sufficient room? If not, this could affect things like the minimum radius on certain curves. A simple example of the space needed would be two termini located on opposite sides of a shed and connected by a main line taken round the garden. How wide should the shed be? From the information above, the recommendation would be 2.4m (8ft) which would accommodate two baseboards 760mm (2ft 6in) wide and a 900mm (3ft) wide aisle for two operators to move reasonably freely.

Layouts in lofts

Lofts often offer the modeller the only chance of building a permanent layout of reasonable size. Even the modern house with its trussed supports can sometimes be adapted. However, lofts also set their own problems for the designer of a layout, they require to be recognised right at the outset. Perhaps the most important is that, unless adequately insulated, a loft can experience very

large changes in temperature. Being over the living spaces of the house, there are likely to be complaints if noise levels are high.

How much width do the rafters and trusses allow when the layout is at the preferred height? Is the width excessively reduced at that height? Establish a compromise and remember to allow for the clearance envelope for the trains, especially on curves. (Figure 1-4)

What sort of access is there to the loft? Can the operators be accommodated in comfort? Can rolling stock be taken up and downstairs in safety? If the layout is to be taken out to events or for other purposes, is the hatch of adequate size and the ladder safe for such use?

1.5.10 Use of mock-ups

Mock-ups, whether of individual buildings and structures or of sections of the layout or indeed of the whole layout, are of great value in ensuring that the essence of the original vision is realised. Great satisfaction can be obtained from building a scenic mock-up, it can become almost an end in itself, offering the chance to test out various ideas for appearance of the projected railway before a final choice has to be made.

A mock-up of a building or a structure will probably consist of a block outline in card or similar material with only such detail as is needed to represent the effect of the structure on the overall picture. Such a mock-up is used to test the effect of a given structure or feature in place on the layout, it is therefore built full size for the railway.

A mock-up of a section of the railway itself may serve many purposes and is generally built to a reduced scale to keep it to manageable proportions. Reductions of between 1/5 and 1/10 give satisfactory results. The objectives are:

- To reveal the effect of the design in selected areas.
- To test the feasibility of the proposed layout with regard to -
  – Horizontal and vertical clearances
  – Adequacy of loops and crossovers
  – Adequacy of sidings
- Adequacy of grade separation on multilevel layouts.
- To test the potential interference with access for operation and maintenance of track and trains.
- To assess viewing sight lines, typically with respect to overall canopies at main line stations.
- To prove the aesthetic effectiveness of the grouping of buildings, structures, and general landscape features. To test these as settings for the trains.
- To develop a satisfactory scheme of lighting.

Construction can be carried out using styrene or foam board for the base with buildings made from cardboard and scenic contours from styrene or other similar materials. This stage of layout design can be very interesting and could even become an end in itself. (See Photo 1.2)

The use of a mock-up for at least certain sections of a layout is particularly apt when the design calls for an 'open plan' or three-dimensional

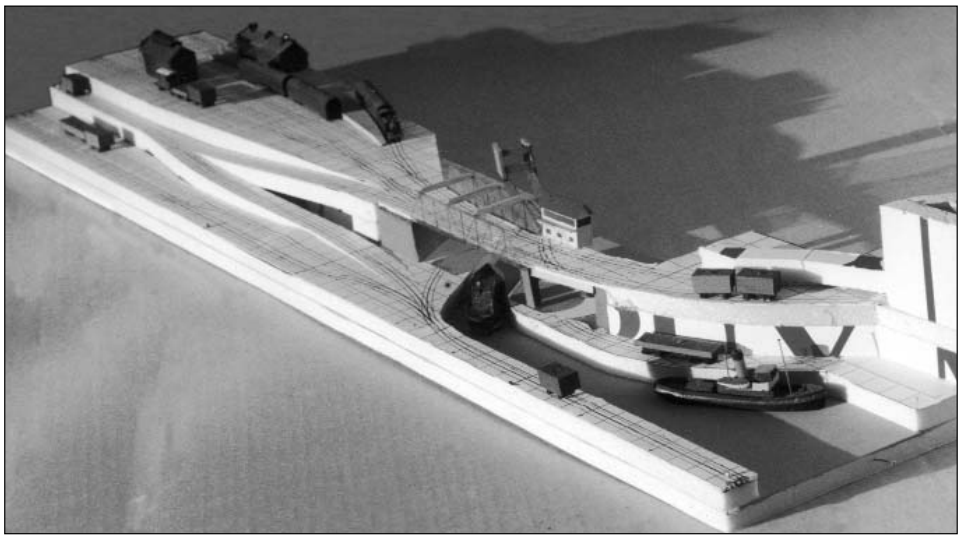

Photo 1-2
An example of a mock up is the harbour scene used to check curves and gradients. The scale is 1/6 the size of the proposed model. The material used for the base is faced styrene, often used for advertising displays. The rolling stock, vessels and buildings are made from similar material and coloured with felt pens and the bridge is made from thin stripwood.

layout. These can be very difficult to visualise, and the accurate design of curved gradients and appropriate gradient transitions are best done with a physical mock-up.

1.5.11 Scenery and settings

The techniques of surrounding a track layout with convincing scenery, or an aesthetically satisfying setting will be discussed elsewhere. However, whatever the ultimate intentions for these may be, they inevitably have a considerable impact on the basic plan of the railway. A viaduct, a tunnel, a cutting or embankment all must be related to adjacent features in a logical and convincing manner. A tunnel should not disappear under a piece of scenery barely high enough to justify a cutting, stations need access from the rest of the world, even if only on the back drop, road-over and under bridges need to seem to be wide enough for the vehicles using them.

Model railways usually begin from the opposite position from the prototype. Modellers create the scenery round the railway, the railway builder had to deal with whatever nature and the owners of the land placed in his way. This upside-down approach makes it difficult to make the model look as if it really belongs in its setting. Try to envisage that setting as it might have been before your line came to be. All the features must seem to be part of one whole. This does not mean that everything in the imagined landscape must be reproduced, not even the most fortunate of modellers have such resources, but the viewer must be able in imagination to see those parts which are not reproduced and be content that they do relate one to another.

The earlier reference to the parallel between this hobby and the theatre should cause us to see our efforts as picture making. Even the starkest setting for a still photograph of a locomotive needs to be composed. Lighting must be right, the background unobtrusive but relevant, the track consistent with the model. Colour is a vital part of the composition, distances can be suggested by a lightening and blueing of the backscene. However the model train moves and it needs to be seen to advantage as it does so. In general curves are more interesting than straights and are at their best when bending away from you. These are the locations on the layout which need your best attention.

A train is a long thin thing, not an easy subject to portray. Railway photographs nearly always show the train in the three-quarter front position. In model form it will be seen from many different angles and needs vertical features to offset these rather boring horizontals; signals, telegraph poles, overbridges, high buildings all help.

Lighting too is important, try moving a portable light about until it gives you a pleasing picture of the train in its setting. You may be surprised how easily the good looking view becomes dull, just through placing the light in the wrong position. The colour of the light is also important, uncorrected fluorescent tubes rarely produce a satisfactory effect.

The elements of the picture need to be a part of the earliest vision of the finished layout and each progressive refinement of the track plan must take account of the effect it will have on the overall picture. Mock-ups are very useful in allowing these inevitable changes to be assessed. Time spent on them is never wasted, a change to a mock-up costs little in time or material, on the layout proper it is usually far otherwise.

1.5.12 Setting out the layout design on the baseboard

With the small-scale plan completed and the overall design fixed, baseboards can now be built and track bases laid. It is still however desirable, as noted in Section 1.4.2, to confirm that all fits together harmoniously before beginning to lay track. When you try to place the actual track units you may find that the intended layout can only be realised with a lot of pushing and shoving, leading to kinks in unhappy places. Look again at Photo. 1.1 of the prototype where however, the trains are heavy enough to push their way through. Model track is relatively much stiffer and the trains lighter, so the vehicles will try to climb over. Make sure that the surface of the baseboard, particularly under turnouts, is free of bumps or changes of gradient, and that the track as a whole can be laid without kinks.

Begin by transferring the centre-lines of the tracks as shown on the small-scale plan to the baseboards and track beds. You thus have a chance to rectify faults that escaped you the first time, before too much effort and material has been committed. Lengths of flexitrack pinned loosely to the centre-lines are also useful planning tools, helping you to identify and deal with the awkward spots.

1.5.13 Using standard turnout components (Options a, b, & c)

Option a)

Where this has been adopted, place copies of the manufacturers drawings of the appropriate size in the positions intended for each turnout.

Option b)

If the manufacturers of the switches and crossings cannot supply full size drawings, draw them out yourself with the aid of any information that you can glean, say from specialist groups. As

an alternative a limited range of drawings for standard turnouts can be drawn out using the offsets as given in Part 2, Section 2.

Option c)

Similar to b) above.

One of the strongest merits of the previous three options is that the turnouts can be built off-site under good conditions of access and lighting. Standardisation of dimensions and the use which this allows of precision made jigs allows components to be bought relatively cheaply or produced rapidly. However, in choosing any or all of them you can seriously limit the fluidity of your design. Turnouts based on the use of manufacturers standard switches and crossing angles tend not to sit comfortably into a freely curving main line and can require a lot of adjustments to the track plan. Where space is tight their use might even lose you your preferred layout. As always, compromise is required, there is usually a place for turnouts made to either of these options, without loss to the layout as a whole.

1.5.14 Turnouts made to measure (Option d)

Here the components are designed and made to suit the needs of each location, giving the best chance of achieving the desired layout. Most modellers will probably progress through the earlier options to discover that the main ingredient needed for success in option d) is confidence, which they should have acquired from their earlier experience. They will also have discovered for themselves the limitations of those options.

As when making the small-scale sketches, you will require full-size drawings for plain line curves. They should cover at least all the minimum radii that you propose to use, and can be made as described in Section 1.5.8. To this add, as before, drawings for radii 1.3 and 1.5 times the minimum. Where you intend to use substandard curves, as in yards or industrial spurs, prepare a separate set of drawings with similar variations on the minimum.

The centre-lines of the layout should by now already be drawn out on the baseboard. For each turnout begin, as you did in the small-scale plan, by drawing it with circular curves from toe to crossing, using a radius 30% greater than your minimum elsewhere. The 1.3 min templates serve for this. At the approaches to any pointwork, draw in any big straights and mainline curves, scaling these up from the original small scale drawing. Draw in both rails, using dividers to place them at half-gauge either side of the existing centre-line to provide marks through which to draw the lines. Do this frequently, as the two lines representing those rails, if drawn with the same face of a template, will not stay parallel over a long distance. If the templates were made specially, with width equal to the track gauge, then this problem does not arise.

In some cases it will be feasible to build turnouts in situ. This can be advantageous, especially where a string of turnouts follow one another closely, they can then be smoothly fared, each one into its neighbours. In general there is then less risk of unwanted bumps and kinks occurring at joints.

Often however, it will be desirable or even essential that actual construction takes place on the bench. Then a removable drawing should be prepared in situ to be transferred to the bench for refinement and as a basis for construction. Before beginning to build however, put the completed drawing back into place on the layout top and make sure that it really does blend smoothly into the adjacent track. Careful checking is essential, rectification in position seldom produces sweet results. A refinement of this approach uses a sub-base, of for example 3mm MDF board, on which has been drawn the outlines of the running rails and other features. On completion, the whole assembly can then be dropped into place and joined to adjacent track.

1.5.15 Adding the details

When you are happy with the track plan that you have now drawn out full size, it can be used to set out the detail work. If you are laying direct on the baseboard surface then the sleeper ends and the edge of the ballast need to be marked out. Similarly if you are cutting and laying separate ballast beds the width of the bed to the cess (drainage ditch – see Figure 1-5) needs to be drawn on the plan. This is also a suitable time to mark the position of lineside features like signals, water cranes, goods yard loading gauges, etc. to ensure that there are adequate clearances between the fixed structures and the rolling stock. These details are set out in Data Sheet D7.1.1.

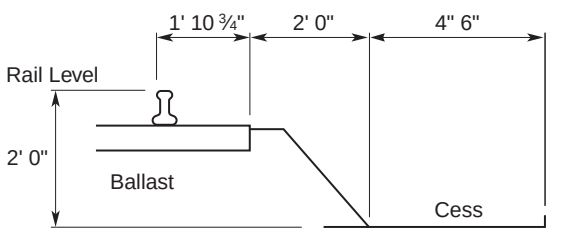

Figure 1-5 Cross section of the ballast bed and cess