

## DESIGN YOUR LAYOUT (ALMOST) LIKE MAGIC!

NMRA-AR 25<sup>th</sup> Convention October 2009

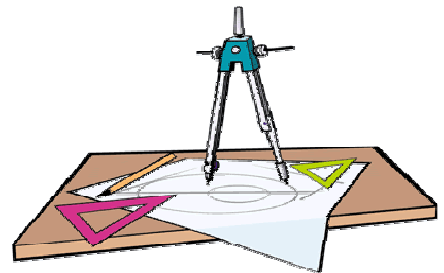
by Lyndon Spence

### WHY DESIGN?

**What does all this stuff have in common?** An aircraft, the Sydney Harbour Bridge, a house, the Egyptian pyramids, a toaster, the Eiffel Tower, the Space Shuttle, or even a toothbrush? If you said: *“they have all been designed”*, you would have to be pretty close to being right on the money. If any of this stuff had been built without design, what mistakes would the builders have made? What money, time or even lives would have been wasted?

**So, why design a model railway layout?** Is your model railway any different? It is made up of hundreds of components. All have to be built and assembled in such a fashion to provide a reliable, low maintenance layout that will be a pleasure to own, operate and display for years to come. Consider the following:

- **Economy** – *My hobby budget is limited. How about yours?*
- **Time** – *As per budget, we all have time constraints as well.*
- **Efficiency** – *Do you waste time on repetitive corrections?*
- **Procurement lists of materials and equipment** – *Do you already have stuff surplus to your needs? Sure, everyone has!*
- **Minimise mistakes** – *Nobody’s perfect. But wouldn’t it be great if we could at least minimise some of our mistakes?*



**Building your layout without design?** Hmm. You can try, but chances are that you may end up with:

- Disappointments.
- Curves too tight.
- Poor reliability.
- Material wastage.
- Grades too steep.
- Early layout burn-out.

**Design like magic?** In the best traditions of Harry Potter or Macbeth’s 3 witches:

*Take some Frank Ellison, simmer with ample helpings of John Armstrong, Paul Mallery and Linn Westcott. Then update your brew with sprinkles of Iain Rice, Joe Fugate, Pelle Søbørg and Tony Koester.*

No. It sure doesn’t work that way! Design like magic? Well . . . . Almost! Did I stretch the truth just a little? At the very least, I’m going to show you a great formula or two for design success. Let’s start gathering the ingredients for our design brew!



### HERE’S A PROVEN FORMULA FOR DESIGN SUCCESS

There are three fundamental steps in the layout design process:

1. **Preparation** – *The research and development (R&D) of all of your layout requirements.*
2. **Concept sketch** – *As per your layout room constraints and layout specifications results.*
3. **Detail design** – *Detail, check and finalise your layout design.*

Would you paint your house, kitchen, bedroom or even that \$1,000 brass locomotive without preparation? No? I didn’t think so. I recently painted my bathroom and honestly, the time spent stripping off the old paint, treating the mould, then thoroughly cleaning the walls and ceiling down, not to mention filling and minor repairs was way more than the time to do the actual painting itself! What if I had not done all that prep work? Well, the new paint probably would look dreadful and not last very long. I imagine it would start to peel and go mouldy again within too short a time, as well as putting a large dent in my housekeeping money. Similarly, you can’t succeed with layout design without adequate preparation.

**PREPARATION** is my key point. It is the foundation stone for the design magic. It will definitely make or break your design. Quite unashamedly, I’m going to devote a major part of this clinic to **preparation**.

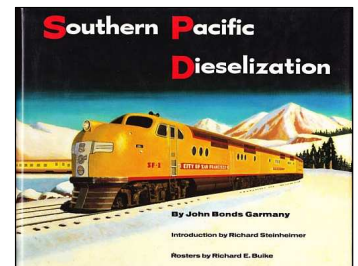
## STEP ONE – THE PREPARATION

### DO YOUR RESEARCH

**Inspiration vs Perspiration.** Is research an almost never-ending quest? Is it a hobby in itself? Probably. The amount of information now available compared to 50, or even 10 years ago, is mind-boggling. Do your research as both a prequel and a compliment to your design. Compile a list of references that will be essential to your final design. Use your computer to keep track, perhaps in spreadsheet format. If new information on your favourite prototype materialises, use it to your advantage in your design. But, don't let it jeopardise good design. Nowadays, resources include:



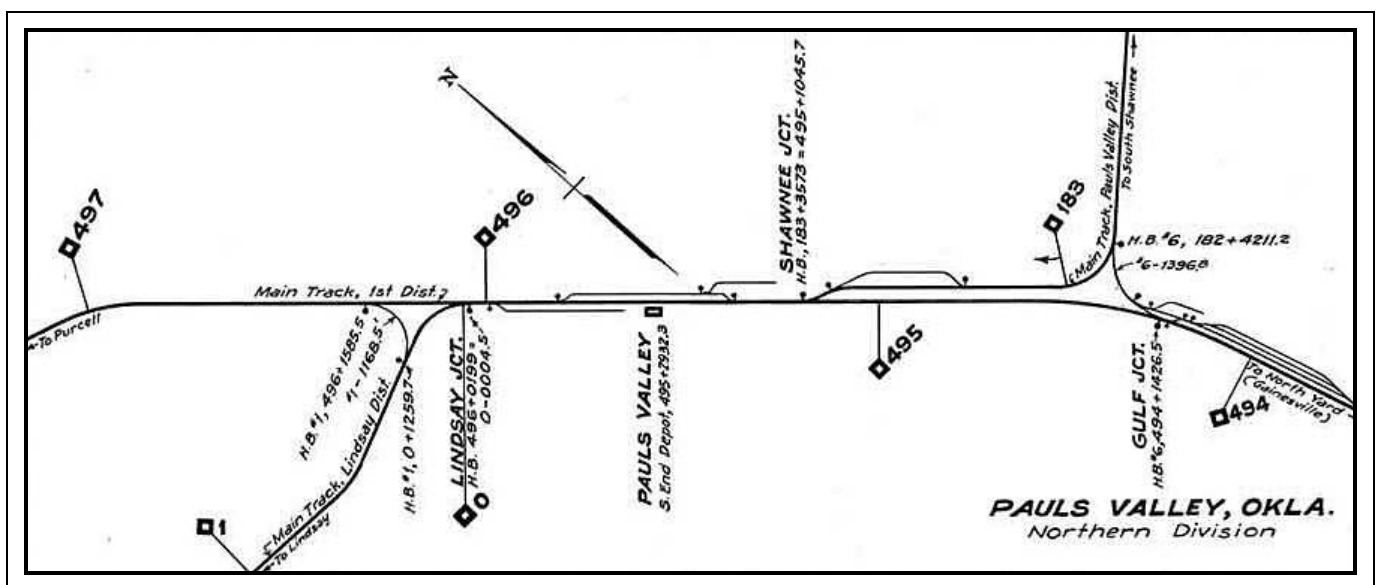
- **Magazines and annuals.** *AMRM, MR, RMC, NGG, Kalmbach's annual Model Railroad Planning.*
- **Model railway books.** *Many available from publishers such as Peco, Kalmbach or Carstens.*
- **Prototype books.** *Many, many books, for sure. Copies of out-of-print books can often be acquired second hand from sources such as eBay.*
- **Timetables.** *Available from internet sites, swap meets and collectors.*
- **Internet.** *Forums, maps, historical, organisation & individual web pages.*
- **Libraries.** *Yep, they still exist & some have research material on line.*
- **Railway historical societies.** *eg ARHS, NSWRTM, SFRH&MS, NRHS.*
- **Model railway clubs & associations.** *NMRA, AMRA & your local club.*
- **Special interest groups (SIGs).** *eg NMRA Layout Design SIG.*



### SUPPLEMENT YOUR DESIGN FORMULA WITH LDES

**Layout Design Elements ( LDE ).** This concept has actually been around for quite a while. But, it took Tony Koester to both define and refine LDEs. They have been covered in Kalmbach books such as *Realistic Model RR Design*, their *Model Railroad Planning* annuals and even one of their recent *Workshop Tips* supplements authored by Tony.

The basic idea is if you come across a prototype plan of say, a junction, station area or engine service facility that could easily be modelled then why not utilise it in your layout design? It would be nice if it was the prototype that you are modelling. But, so what if it's not? If the prototype used it, your design will be the more plausible. Use one as a main feature of your design and build on it. Or, use several LDEs right throughout your layout design. Don't dismiss this idea if you are strictly freelance, you'll surprise yourself how you can still use LDEs to your advantage.



## DO A SELF-ANALYSIS OF YOUR LAYOUT REQUIREMENTS

You've done your research. You've been in the hobby long enough to know what you like and what you want to model. On the way, you've picked up plenty of stuff and looked at plenty of track plans. Don't keep your ideas in the back of your mind. Sit down and get all your layout requirements and specifications down on paper. Alternatively, document using good old spreadsheet formats. John Armstrong used many clever design techniques. Allow me to show you some of John's ideas and then modify them to help you do a self-analysis of your own layout design requirements.

### THE LEGACIES OF JOHN ARMSTRONG

**John Armstrong** was a prolific US designer who sadly passed away in 2004. If you do a search on the Kalmbach model train magazine index you will get over 330 hits. Some of those hits will include dozens of books he authored on both model railways and the prototype. Some texts were even used by real USA railroad companies for training purposes. Right from its inception, his O-scale **Canandaigua Southern** layout had many innovative and original design ideas. We can still learn a lot from some of John's published ideas including:

- **Your operating style.** *Are you an engineer, dispatcher or spectator?*
- **The relative emphasis.** *Analysis of your needs. Track vs scenery. Mainline running vs switching.*
- **Givens and druthers.** *Your layout design mandatory factors plus your wish list.*
- **Doodling by the squares.** *A quick method of checking layout design options for a given space.*

### YOUR OPERATING STYLE

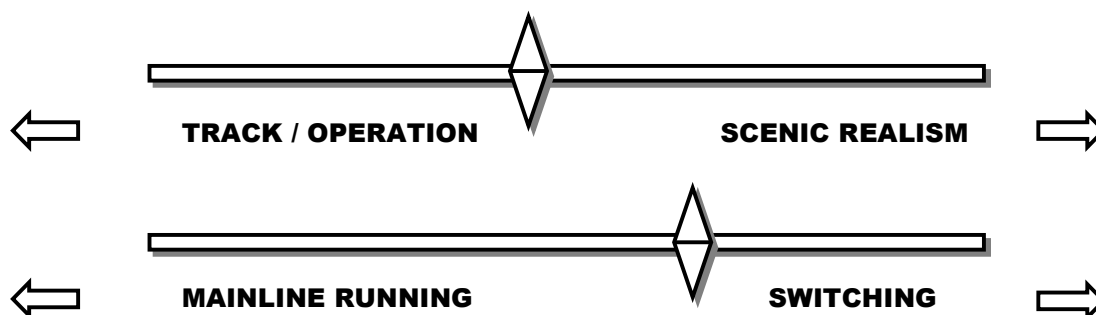
Are you an engineer, dispatcher or spectator? John first described this technique of identifying operating styles in an article titled "*Build Your Pike to Suit Yourself*" in the November 1954 issue of *Model Railroader* magazine. Maybe you are a combination of two or even all three types? Early identification or recognition of your unique operating style will greatly assist your layout design.

- **The Engineer** *is hands-on and enjoys driving trains with plenty of switching and making up of trains. The engineer may be less interested in timetables or train watching.*
- **The Dispatcher** *loves train meets and timetabling. Switching and scenery have lower priorities. However, ample passing sidings to assist train operation are featured.*
- **The Spectator** *is also a rail fan. Loves to run and watch trains. Operation is not as important as the thrill of watching trains run through towns and scenery.*



### THE RELATIVE EMPHASIS

As a professional layout designer, John used to send his clients a four-page questionnaire. Included in this was an exercise he called "**Relative Emphasis**". He devised and used simple sliding cursors to help his clients clarify their ideas. Refer to the diagrams shown below. Moving the top cursor towards the **track / operation** end will be at the detriment of **scenic realism**. Similarly, a move of the bottom cursor across to **switching** may affect **mainline running** features. Vice-versa applies. You too, can also use these sliders to help you get your operating balance right.



## GIVENS AND DRUTHERS

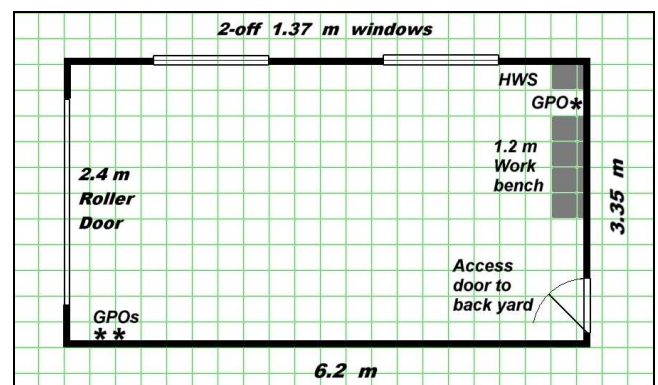
**GIVENS.** Your *Givens* list consists of your mandatory factors. In other words, stuff you either cannot change or simply have no desire to change. For simplicity's sake, I'm going to subdivide your *Givens* list into three modules:



- Your **REAL ESTATE** - *This, of course, is your layout room.*
- Your **RAILWAY PROTOTYPE** – *Your prototype's attributes.*
- Your **MODEL RAILWAY LAYOUT** - *Your layout's idiosyncrasies.*

**GIVENS – YOUR REAL ESTATE.** Consider this module as the most important mandatory factor list of the three. It may well be a little difficult to build the Grand Central Union Station in O-scale in a spare room only 3m x 2m! As well as the *Givens* table below, you have to also prepare an accurate scale drawing of your layout room. Carefully record all details of your room inclusive of fixtures such as windows, doors, utility services and water or sewage piping.

GIVENS	MY LAYOUT ROOM
DIMENSIONS	<i>Your usable area, rather than overall.</i>
TYPE OF ROOM	<i>i.e. garage, spare room, yard shed.</i>
ROOM FIXTURES	<i>Utilities, sewer, water pipes, A/C ?</i>
CEILING	<i>Height &amp; type. E.g. Suspended.</i>
LIGHTING	<i>Fixed light fittings or relocatable.</i>
WORK BENCH	<i>Fixed workbench or modellers desk.</i>
DOORS	<i>Size &amp; location of doors.</i>
WINDOWS	<i>Ditto for windows.</i>
POWER OUTLETS	<i>Number and locations.</i>



GIVENS	MY RAILWAY PROTOTYPE
GAUGE	<i>Narrow, standard or broad.</i>
PROTOTYPE	<i>e.g. NSW, VR, BR, UP, ATSF ?</i>
ERA	<i>Vintage, transition, modern?</i>
RR CLASS	<i>Class 1 or down-and-out secondary.</i>
GEOGRAPHICAL	<i>NSW? NZ South Island, Utah? Cajon?</i>
SCENERY	<i>Farmland, prairie, mountains, coastal?</i>
MOTIVE POWER	<i>Steam, diesels, electric, all ?</i>
TRAIN TYPES	<i>Freight and/or passenger trains</i>
INTERCHANGE	<i>Any interchange &amp; with what roads?</i>

### GIVENS – YOUR RAILWAY PROTOTYPE.

Now prepare a similar table describing all of your chosen railway prototype's mandatory factors. This should include the attributes, essentials and characteristics that make your prototype unique. The example at left shows what this may include.

GIVENS	MY MODEL RAILWAY LAYOUT
SCALE	<i>Z, N, HO, OO, S, O, G, whatever?</i>
STYLE	<i>Continuous, dogbone, point-to-point?</i>
MIN RADIUS	<i>Mainline, sidings &amp; industrial.</i>
TURNOUTS	<i>Mainline, sidings &amp; industrial.</i>
MAX GRADE	<i>Mainline &amp; branch lines.</i>
OP GOVERNANCE	<i>Full length pass cars? Artic steamers?</i>
CONTROL TYPE	<i>DCC, DC, walkaround?</i>
MIN AISLE WIDTH	<i>Are you BG or NG?</i>
OPERATING CREW	<i>Loner or multi crew/operators.</i>

### GIVENS – YOUR MODEL RAILWAY LAYOUT.

Yep, another table describing your model railway layout's mandatory factors. Here's another example of such a table.

**DRUTHERS.** This is an American slang word that John loved to use. Its origin is a corruption of *I'd rather* or *'d rather*, i.e. your wish list. This will be the stuff you would love to include on your layout. But realistically, life is a compromise and you may not be able to achieve all of your *Druthers*. Don't worry if your list is long and optimistic. That doesn't matter; as long as you have one. Typically your *Druthers* list could look like this:

- Minimal hidden track.
- Easy access to turnouts.
- At least three towns.
- Realistic scenic transitions.
- Generous staging yards.
- Harbour with car ferry.
- Features unique to area.
- Several types of industries.
- Few duck-unders.
- Remote-control turnouts.
- Local control panels.
- Walkaround control.
- Loco servicing facilities.
- Thru freights & local turns.
- Streamliners & locals.
- Facility to turn trains.
- Major junction.
- Block signaling.

**Doodling by the squares.** John prepared "squares" with dimensions based on a layout's scale, parallel track centre line spacing and minimum radius. He then used these squares to roughly work out model railway design concepts to suit the layout space available. Unfortunately, a full description of this technique would take up too much space in this clinic. Refer to the November 1980 issue of *Model Railroader* magazine for a further details of this method.

### YOUR INGREDIENTS FOR YOUR MAGICAL DESIGN BREW ARE NOW READY!

Now, you have a formula for some design magic! By now, you should have the essential ingredients identified and carefully recorded. If you have prepared them with the help of your computer, print them out. Stick your print-outs up on your layout room's walls for study and review. You should now have:

- Your prototype research results.
- Your selection of Layout Design Elements.
- Your operating style identified.
- Your relative emphasis (sliding scales) prepared.
- Your layout room defined with special attention to usable space.
- Your layout room's scale plan accurately drawn up.
- Your givens for your railway prototype tabled.
- Your givens for your model railway layout tabled.
- Your druthers listed.



### ON TO YOUR NEXT STEP – BREW THE DESIGN MAGIC

Would you believe the hardest part is almost over? With all of the ingredients of your formula now identified, all you have to do is produce the design drawing!

Yeah, I know, I'm guilty of just a little exaggeration again! But, taking one step at a time and being patient, you can and will produce your design with fewer hassles than you think.



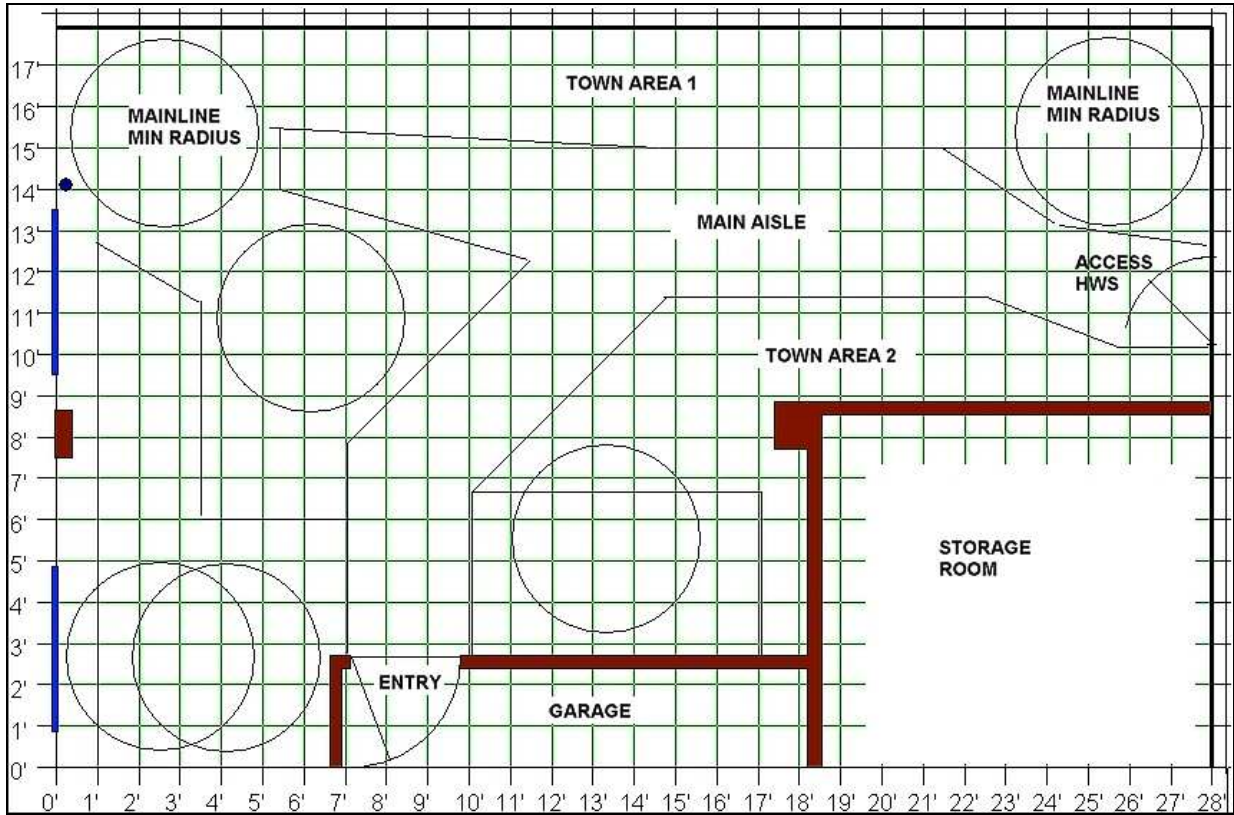
### STEP TWO – THE ROUGH CONCEPT SKETCH

**There are a couple of ways** you can do this. You could use John Armstrong's "*Doodling by the Squares*" method or just grab your scale plan of your room and start drawing arcs set to your layout's defined minimum mainline radius. Personally, I find the latter method the simplest and quickest.

**The two most critical factors** of this technique are your room's usable area and the minimum mainline radius. Once you start sketching, you'll soon find out what you can or cannot do in your defined space. The idea is to rough up a concept plan of your mainline run. Details such as sidings, yards, industries etc will come in the next step. Take into account main access aisles as well as areas needing access for construction and maintenance.

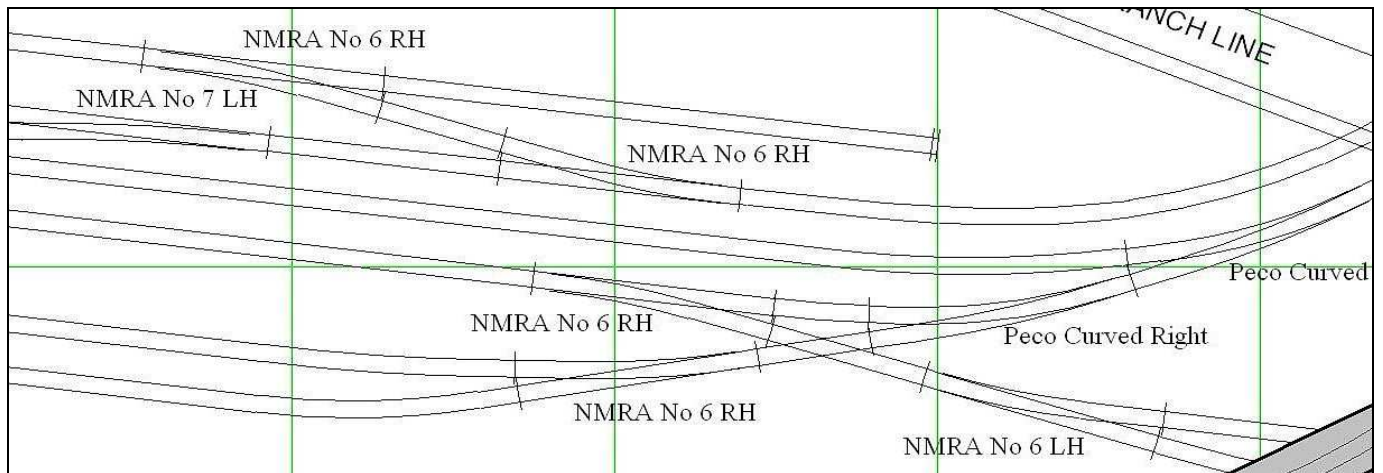


**Do lots of sketches.** Only some will get close to what you want. If you're using one or two Layout Design Elements, you may be forced to do some selective compression or bend the tangents to get the LDE in your space. That's OK. You will get there. Don't forget to separate S-curves with tangent track at least the length of your longest item of rolling stock.

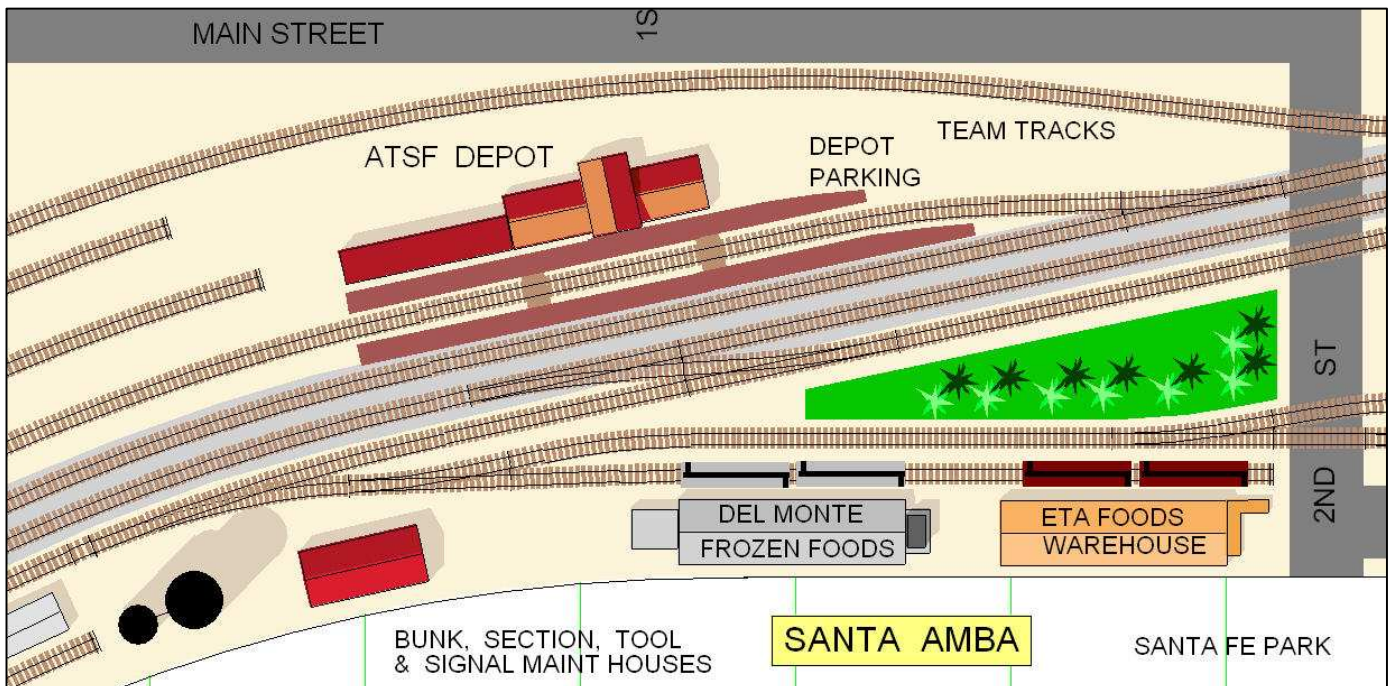


**STEP THREE - THE DETAIL DESIGN**

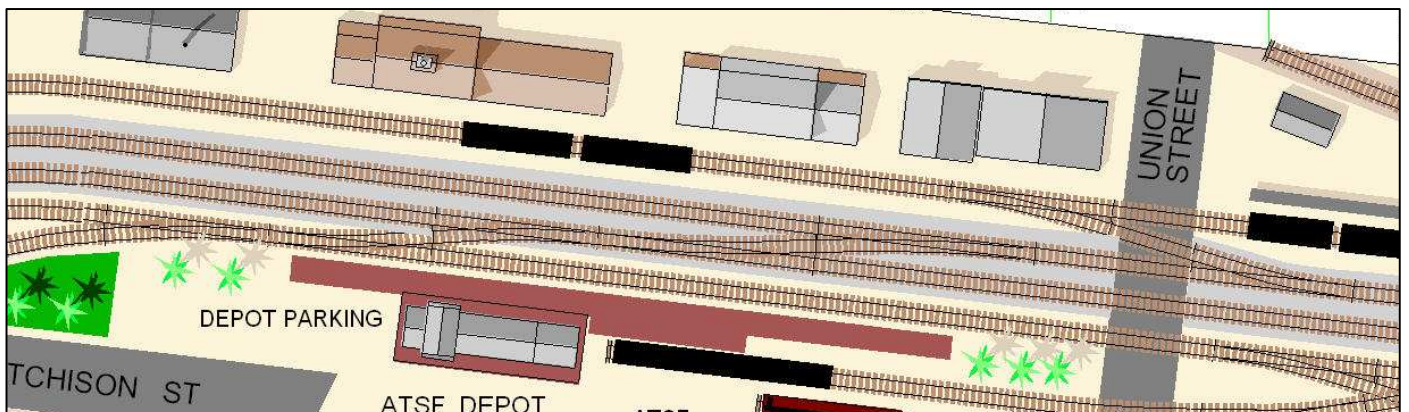
**The detail design.** Next: on with your detail design. Keep asking yourself if you are keeping with your original prototype and the layout specifications originally identified during your preparation stages. Add your passing sidings, stations, industries, loco servicing. Detail your staging yards. Try different ladder arrangements. If a simple ladder won't work because of the space it gobbles up, try a compound ladder instead. Remember the basic rules for track standards such as parallel track separations, easements, grade separations, tangents between S-curves and so on.



**Name 'em!** Name your towns, rivers, roads, scenic features and industries. This is a simple action that identifies your railway's geographical location, its purpose and personality. Anyway, if you have included any Layout Design Elements in your layout design, the prototype will have already done the naming for you.



**Checking your design.** Your checking process must be thorough. You don't want to find out the hard way that your Union Pacific articulated is going to side-swipe your streamliner on parallel curvature. Nor do you want complicated track-work in an inaccessible corner of your layout. Share your plan with some friends and ask them to give you some constructive criticism. They may see something obvious that you have overlooked. If you've worked closely with a project over a long period, it is very common that the most obvious errors will not be noticed by you. In the professional design World, this happens all the time. It's sort of akin to the old saying: *"you can't see the woods for the trees"*.

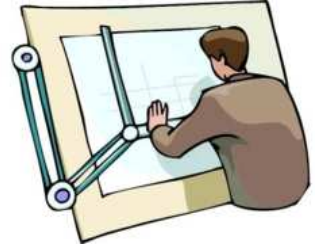


**Corrections and finalising.** Do your corrections, check again, correct again and attempt a finalised design. But, like all good model railways that are never supposed to be finished, you need to keep your mind open. You never know; a day, a week or months later something will pop into your mind, you may see a photo or receive a suggestion that may inspire you to re-think your plan. In other words, don't be afraid to revise your plan. Finalised, then? Maybe?

## CHOICE OF DESIGN DRAWING MEDIA

Until relatively recently, choice of drawing media came down to these:

- **Sketching.** Rough and ready sketches. Writing or sketch pads, even the back-of-an-envelope.
- **Graph paper.** A great step forward. Graph paper with graduations suited to your drawing scale. Your essential hardware would include scale rules, tee square, protractor, a compass set, circle gauges and French curves.
- **Drawing board and machine.** By “*machine*”, I refer to some sort of device that automatically keeps your straight edges parallel and square to your work. For example, a track machine or pantograph type drafting machine. The essential hardware items described above are also utilised.
- **Full-size plan.** This would involve drawing a full size plan on butcher's paper. Your own track components such as turnouts and crossings are used as templates and simply traced around.



But, not everyone has the skills necessary to draw. Having spent most of my working career as a design and project management professional, I'm the first to acknowledge that. The computer age has revolutionised tasks in industry, commerce and office. So, let's step up to the computer age with the ultimate design step:

## COMPUTER-AIDED DESIGN or CAD

**A short history of CAD.** Computer-Aided Design or CAD systems have actually been around longer than you might think. They can trace their roots to US military needs in the mid-1950s. But, shortage of computer capabilities and expense meant that there was a long gestation period. CAD developers included MIT, General Motors, Ford, Lockheed and McDonald-Douglas. It wasn't until the 1980s that they became more available and easier to use. By the end of the 1980s several CAD companies had emerged that were successful in providing CAD systems to customers all over the World. In the 1990s PCs became powerful and affordable enough to run CAD software.

**Who can use it?** Remember not so long ago, companies depended on typists for any typing tasks? With the PC revolution, anyone lacking typing skills could now do their own word processing. Corrections, alterations, copying and pasting text were so much easier. Similarly, CAD has revolutionised how companies are structured. Architects or engineers no longer have to give their sketches to detail draftsmen to draw up. Instead they can directly produce their designs in a neat, accurate, finished drawing. Accuracy is improved; drafting and hand lettering skills are not an essential requirement and boy, the ease of any alterations and corrections!



**CAD Advantages.** There are a zillion advantages of CAD drawing compared with any other method. E.g.

- Accuracy & speed.
- Ease of drawing, lettering.
- Ease of corrections, alterations.
- Copying objects & complete designs.
- Using built-in library objects.
- Efficient storage of designs.
- Print out designs in various scales.
- Print out full-size drawings.
- Uses cheap, readily available hardware.
- Less paper wastage.
- Less dependence on drafting skills.
- Can be emailed to colleagues & friends.
- Less office space taken up (compared to drawing board & machine).

**CAD Disadvantages.** Not that many, strangely enough. One big one as follows, but the second one not so much of a deterrent these days.

- Steep learning curve.
- Expense of both hardware & software.



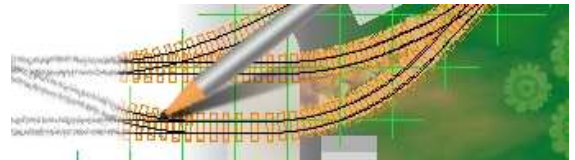
**CAD systems available.** There are many commercial systems now available. In simple terms, it comes down to two choices: Either a generic CAD type aimed at all user types. i.e. engineering, architecture, professionals or hobbyists or CAD software designed specifically for model railway layout design.

**BUT WAIT! There's more!**

**THIS IS THE BEST PART: One of the simplest and easiest-to-learn model railway layout design CAD systems is now FREE!**

### **XTrkCAD.**

**My recommendation.** There is no way I'm going to endorse any commercial CAD system, when this one is so darn good and available to anyone as a free download!



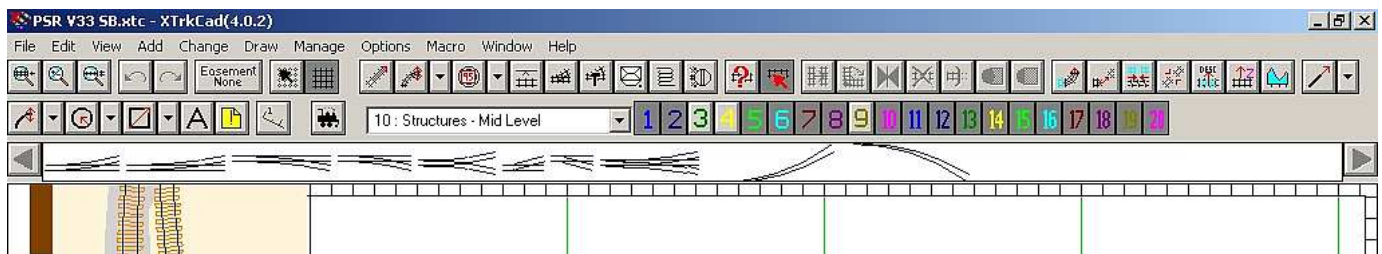
**XTrkCAD** is open source software, so it really is a free download. No strings, time limits or obligations attached. It does not take up much space on your hard drive - less than 5 MB complete with its included track and structure libraries. XTrkCAD started off as a commercial product written by some very clever Canadian model railroaders for LINUX. Later, not only did it become open source but also available for both the Windows and MAC operating systems as well. Further good news is that it is continued to be supported and upgraded by not only the original authors, but model railway enthusiasts from all over the World.

This has become my preferred model railway design CAD programme. I searched for a relatively easy to use layout design programme and was prepared to pay good money for it. Then I found XTrkCAD about 18 months ago. What a bargain! I then put a friend on to it and he was hooked within the week.

**XTrkCAD** will also let you design control panel layouts complete with turnout and signal indications.

### **Some of the many features of XTrkCAD:**

- Minimal system requirements.
- Major manufacturers' track supported.
- NMRA standard turnouts in its library.
- Working with flex-track is a breeze.
- Easy to design your own objects.
- Any scale, gauge or layout size.
- Learn at your own pace.
- Tutorials available on line.
- Built-in animated help feature.
- Will create full-size track templates.
- Automatically draws easements.
- Generates grade profiles.
- Generates material lists.
- Benchwork design capability.
- Run a virtual train to test your design.
- Up to 99 layers of editable graphics.



### **HOW or WHERE DO YOU GET IT?**

Just go to the XTrkCAD home page at: <http://www.xtrkcad.org/Wikka/HomePage>

**Learning & using XTrkCAD** Persevere with it and you could be drawing within a week. BUT . . . .

This is almost mandatory; find the tutorials on the XTrkCAD site and print them out. You need to do the tutorials first

before you can progress. It's worth repeating: **you do have to print out the tutorials first.** English enthusiast, Mike Sutton, has also published on the web some very helpful tutorials in 4 parts. Mike's first part is at:

[http://smallphry.com/eecore/index.php?/site/xtrkcad\\_tutorial\\_part1/](http://smallphry.com/eecore/index.php?/site/xtrkcad_tutorial_part1/)

For further help or encouragement, there is a Yahoo XTrkCAD support group at:



<http://groups.yahoo.com/group/XTrkCad/>

**Printing out your XTrkCAD designs.** When it comes time to print them out, the XTrkCAD software includes a great little printing utility that allows you to print out your designs in any scale including full size. About your only limitation will be the capabilities of your printer or plotter. Even though it is capable of quite sophisticated layout design including 99 multi layers in full colour, the format it uses results in file sizes being quite small when compared to other graphic formats such as bitmap or jpeg. Therefore, complete and complex layout designs can be easily shared and emailed between users.



## ACHIEVING DESIGN SUCCESS

Space restraints are such that it has been impractical to pass on detailed descriptions of successful design processes. But, I do hope you have picked up at least one or two concepts or ideas that will help you to achieve your dream design. Remember my formula for performing design magic? The first step is so important that I am going to repeat it:

**Preparation.** Do your research. Your R & D. Prepare an accurate plan of your layout room and do your self-analysis of all of your own requirements for your layout. Perhaps you may get lucky and find a published plan that will suit you? Even if you have to do a few minor modifications here and there? Another "maybe"! At the very least, I have no doubt that you will pick up some great ideas from others' track plans that you may be able to utilise in your own design.

Layout design is such a complex topic that there have been dozens of books written on the subject. From Frank Ellison writings of the early 1950s through to Iain Rice and Tony Koester's of the 2000s, there has been some great stuff published. So in closing, here is a short list of my favourites. The out-of-prints (OOP) are well worth tracking down.

- 18 Tailor Made Model RR Track Plans – John Armstrong (Kalmbach - OOP)
- Creative Layout Design – John Armstrong (Kalmbach - OOP)
- Design Handbook of Model Railroads – Paul Mallery (Carstens - OOP)
- Mid-sized & Manageable Track Plans – Iain Rice (Kalmbach)
- Realistic Model RR Design – Tony Koester (Kalmbach)
- Track Planning for Realistic Operation – John Armstrong (Kalmbach)

