

## Bringing Elegant Solutions to PCB Layout Design

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In his book *In Pursuit of Elegance*, Matthew May says that elegant solutions “have the unique and elusive combination of unusual simplicity and surprising power.” Elegant design goes beyond simple functionality to create products that are intuitive, cost-effective, and beautiful.

Elegant solutions in printed circuit board design can lead to better circuit performance, higher yields, and ease in implementing design changes. At Stilwell Baker, Elegant Design is more than a methodology—it’s a philosophy employed by talented designers when the customer is striving for a better product.

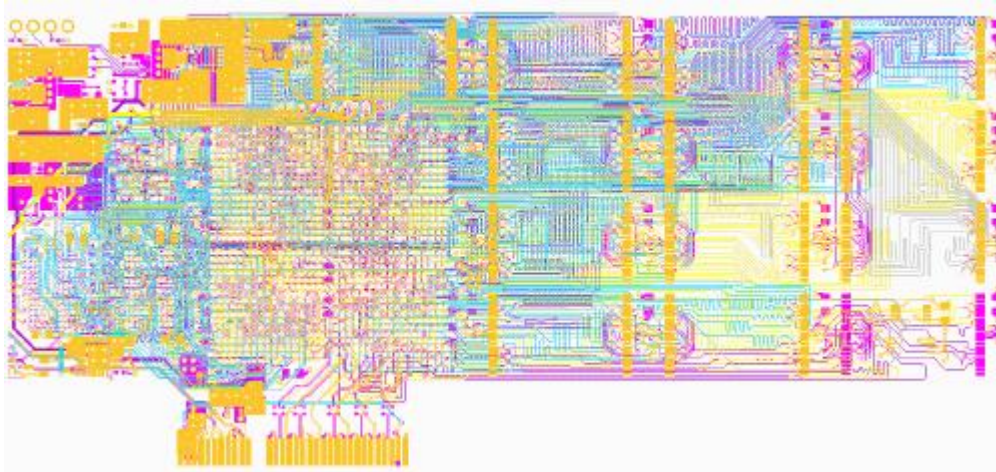
May characterizes elegance by four key elements: **Symmetry, Seduction, Subtraction, and Sustainability**. All of these elements came together in a recently completed Stilwell Baker project. Designers were challenged at the outset by a large section of the board where the net length rules weren’t defined. The issue was resolved by applying the fundamentals of Elegant Design at every step of the process, from pre-layout planning to verification and design review. There is no easy formula for Elegant Design—an experienced designer applies all of these elements concurrently and with artistic attention to detail.

### Symmetry

Symmetry in board layout means using routing channels as efficiently as possible. Components, fanouts, and interactive vias are aligned, creating clearly defined placement blocks. This ensures that usable space is maximized and that modifications can be made easily. It also facilitates assembly and rework. Symmetric boards are laid out according to a clear master plan, conceived before beginning layout.

### Seduction

May’s idea of seduction in design differs from that of Stilwell Baker. May argues that seduction is achieved through ambiguity—withholding information from the user to excite the user’s interest. Ambiguity has no role in PCB design. Clarity is essential. An elegantly designed board communicates information to an engineer: schematic blocks are placed logically and separated according to function, and a consistent color-code scheme within the PCB layout tool allows the engineer to easily identify critical nets. Clarity, consistency, and order pay off in the verification phase, during design review, and during future redesigns.



*Executed elegance in a complex design*

### **Subtraction**

Every board is designed from the top, according to a thorough plan. It is essential to have the overall design intent in mind while working on the details. A PCB has a limited number of routing channels and they are often wasted by inefficient placement. Often up to 20% of routing channels are made unavailable from the start because of the lack of an overarching plan, resulting in a 20% hit on board utilization. Complex problems are solved through disciplined application of simple good practice.

### **Sustainability**

Boards are designed for manufacturing as well as assembly from the outset. A pre-layout meeting ensures that all engineers are familiar with the design intent as well as design constraints—electrical *and* mechanical. Before beginning the layout, factors such as the library and the build quantity should be understood. How many boards will be built? Ten? Or a million? The answer determines the library to be used as well as placement decisions—what works for a hand-assembled prototype may not translate easily to volume production. The fabricator should be consulted before layout to determine any additional design constraints that may arise in assembly. Sustainability follows from symmetry, seduction, and subtraction—design for change, know what the board will look like before it's layed out, and plan for manufacturing as well as functional spec.

The application of Elegant Design was instrumental to the successful completion of Stilwell Baker's recent project. The design was very complex, with over 90% of the nets constrained, and the schedule was aggressive; despite the undefined net lengths, layout had to proceed in parallel with engineering definition. By working with a thorough master plan and

utilizing efficient routing, the matched-length traces were laid out in a way that allowed the lengths to be manipulated without affecting the rest of the design. By separating circuits by area or layer and laying out the fanouts early and in alignment, the designers were able to freely manipulate the trace lengths while keeping them running cleanly through the carefully aligned parts and vias. By applying the principles of Elegant Design to the problem, designers were able to quickly and efficiently react to changing engineering definitions and deliver a complex design successfully and on time.

Time is often one of the major constraints in a design. Yet Elegant Design needn't take longer or cost more. Elegant Design is a philosophy that ensures that a PCB layout is done right the first time. Extra care in planning yields payoffs in layout and assembly as it minimizes the necessity of future changes and maximizes yield and board utilization. Elegant Design doesn't come from process or technology—it is a methodology practiced by talented, experienced designers. Stilwell Baker believes that Elegant Design produces higher quality design and more value for our customers. It has been part of our approach from the beginning—refined over fifteen years of world-class PCB design.

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