REVIEW ON DESIGN OF BACK PANEL OF CPU FOR IMPROVING UTILIZATION OF MATERIAL

VAIBHAV JAGDEO RAUT
M.TECH (CAD\CAM)
G.H.RAISONI COLLEGE OF ENGINEERING, NAGPUR.

Abstract:
This review paper is for Design of back Port Panel of CPU for Improving Utilization of material by using latest methodology, comparing previous Manufacturing process. This review paper gives best way to utilize material for providing maximum number of ports to connect external devices.

INTRODUCTION:

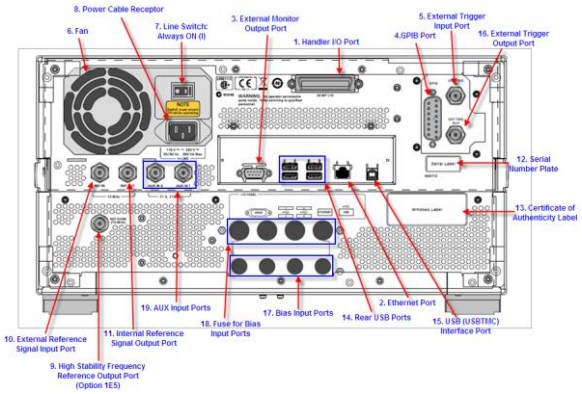
A computer case, usually referred to as a computer case, is the casing that contains the majority of a personal computer's essential hardware parts. The CPU, motherboard, RAM, mass storage devices, and other expansion cards are examples of internal hardware, whereas accessories are often cord or plug-and-play equipment such the display, audio, keyboards, and mouse that are located outside the casing.

Chassis or panel of the CPU provides support to the internal component and act as a covering panel. Ports are provided for to connect external devices & Air vents are provided for heat transfer, to stay microprocessor and internal part cool so that it can gives maximum performance Traditional computer casings are completely enclosed, with just a few small air holes (mainly in the rear panel) and cutout areas for sockets and plugs (back) and accessibility to external hard drive bays (front). Typically, a panel's structural frame (chassis) is made of rigid metals like steel (typically SECC, or steel, electrogalvanized, cold-rolled tube) and superalloys, with hardpoints for installing internal hardware, case fans/coolers, and controlling cable routing. The exterior case panels are typically made of coloured metallic and/or polycarbonate material, though other materials like weave, tempered glass, acrylic, wood, and even Lego pieces have emerged in many contemporary commercial or home-built cases. The outer case panels wrap the chassis on the front, sides, and top to safeguard the internal parts from intruding and dust collection, and (at least one of them is removable). In the luxury gaming PC market, open framed or open airflow cases that are just partially enclosed (with truly free ventilation and potentially greater cooling) have recently been accessible.

BACK PANEL OF CPU:

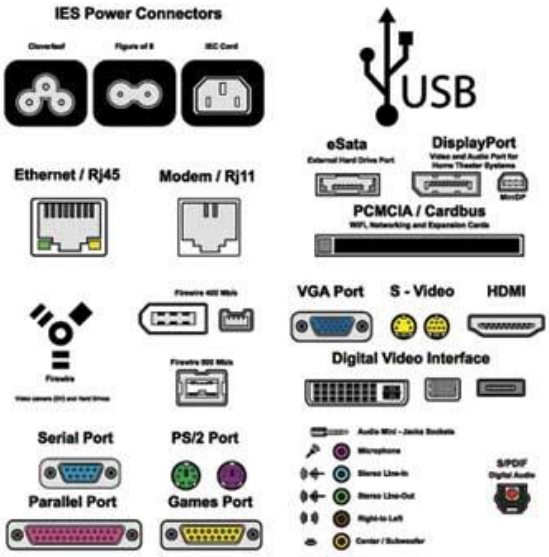
You may attach gadgets like a monitor, microphone, keypad, and touchpad to the rear plate of any computer. As can be seen in the image below, the rear panel is bordered by the motherboard. While mounting the motherboard, the back panel, located on the device's back side, is inserted into the I/O plate.

The figure below shows the connections that are only on the rear panel. If you've never seen a board before, check for the connections on the back of each machine.[4]



Relative to the more readily available face panels connectors with the devices, back panel interfaces were usually joined or withdrawn less frequently. For instance, speaker connectors, foot switch plugs, and charging cable connections are often located on the "back panel" of a tube preamp since once attached, they are seldom changed until the amp is transferred. Each application involves extensive use of the inputs and operating cycles on the front panel. The same impact would apply to PCs and DVRs alike.

PORT PROVIDED ON CASE[2]:



There are two variants of the serial port: a 9-pin and a 25-pin type. Data moves at a speed of 115 kilobits per second, Serial port is used to connect external and older computer mouse.
Parallel port, also known as printer port, is a Centronics port that complies with IEEE 1284 and is employed by scanners and printers.It contains 25 pins.
Most older computers include two PS/2 ports, one for the keyboard and the other for the mouse. PS/2 ports are also known as mouse ports. Centronics port that complies with IEEE 1284
USB port: Universal Serial Bus
• It can connect to any type of external Usb connection, including a mouse, keyboard, external hard drive, printer, scanner, and more.

• The item debuted in 1997.
• Most computers come with a least of two USB ports.
Data moves at a rate of 12 megabits per second.
Gadgets that are USB compatible can obtain electricity from an Usb connection.
The VGA port, which has 15 holes and functions similarly to a serial port connection, links a computer's graphics card to a display. Whereas the VGA port has slots, the serial port connection has pins.
Power Connector: Three-pronged socket; links the computer's power line to the electrical outlet or power bar.

- Thunderbolt Port
- Connects video equipment such as camcorders to the system and transfers huge amounts of data quickly.
- Data moves at a speed of 400 to 800 megabits per second.
- Apple came up with it.

- Three variations exist: FireWire 400 connectors in three different pin counts: 4-pin, 6-pin, and 9-pin.
The VGA port, which has 15 holes, connects the computer's video card to the display.
• Comparable to the connection on a serial port. Whereas the VGA port has holes, the serial port connection has pins.
Plug with three prongs for power.
• Attaches to the computer's power cable, which is plugged into an outlet or power strip.
Bluetooth Port
• Moves a significant quantity of data quickly.
• Attaches video and camcorder equipment to the PC.
400 to 800 megabits of data are sent per second.
The 4-Pin FireWire 400 connection, 6-Pin FireWire 400 connector, and 9-Pin FireWire 800 junction box were all developed by Apple.
[3]

MANUFACTURING OF PANEL:

The back panel of a CPU, also known as the I/O panel or I/O shield, is typically made of metal and is used to protect the connectors on the back of the computer case. It is usually made by stamping or punching the metal into shape and then attaching it to the computer case. The process of manufacturing the back panel typically involves the following steps:

1. Design: The design of the back panel is typically done using computer-aided design (CAD) software. The design takes into account the dimensions and layout of the connectors on the back of the CPU as well as the size and shape of the computer case.
2. Cutting: Once the design is finalized, the metal for the back panel is cut to the appropriate size and shape using a laser or other precise cutting tool.
3. Stamping or punching: The metal is then stamped or punched to form the various openings and features of the back panel. This is typically done using a stamping or punching machine that applies pressure to the metal to shape it.
4. Finishing: The back panel may be finished with various treatments, such as painting or plating, to protect it from corrosion and improve its appearance.
5. Assembly: The back panel is then assembled onto the computer case using screws or other fasteners.

This process can be done manually or with the aid of automated equipment, depending on the volume of back panels being produced.

*There are several different manufacturing techniques that can be used to produce the back panel, including:

1. Stamping: This is a common method for manufacturing the back panel. It involves using a stamping press to apply pressure to a sheet of metal, which is then shaped into the desired form.
2. Punching: Punching involves using a punch press to cut or shape the metal using a variety of tooling.
3. Laser cutting: This technique involves using a laser beam to cut the metal into the desired shape. It is precise and allows for complex shapes to be cut with a high degree of accuracy.
4. Waterjet cutting: This method involves using a high-pressure stream of water to cut the metal into the desired shape. It is often used for materials that are difficult to cut with other methods.
5. EDM (electrical discharge machining): This process involves using electrical sparks to erode the metal and create the desired shape. It is often used for intricate shapes and is highly accurate.

The manufacturing method used will depend on the complexity of the back panel design and the materials being used.

*The most common materials used for the back panel include:

1. Steel: Steel is a strong and durable material that is commonly used for the back panel. It is an alloy of iron and carbon, with small amounts of other elements such as manganese, sulfur, and phosphorus.
2. Aluminum: Aluminum is a lightweight and corrosion-resistant material that is often used for the back panel. It is a silvery-white metal that is abundant in the earth's crust.
3. Brass: Brass is a yellowish alloy of copper and zinc that is known for its strength and corrosion resistance. It is often used for the back panel in high-end computer cases.
4. Stainless steel: Stainless steel is a strong and corrosion-resistant material that is often used for the back panel. It is an alloy of steel and chromium, with small amounts of other elements such as nickel and molybdenum.

In addition to these common materials, the back panel may also be made of other metals or alloys depending on the specific requirements of the computer case.

There are many companies that manufacture back panels for PC cases. These panels are typically made of metal or plastic and are used to cover and protect the internal components of a computer. Some of the well-known companies that produce back panels for PC cases include:

1. Lian Li: Lian Li is a Taiwanese company that is known for producing high-quality PC cases and related components. They offer a range of products that include back panels for various types of PC cases.
2. Phanteks: Phanteks is a Dutch company that produces a variety of PC cases and related components. They offer a range of back panels for different types of PC cases, including models that are designed for use with water-cooling systems.
3. Fractal Design: Fractal Design is a Swedish company that produces a range of PC cases and related components. They offer a variety of back panels for different types of PC cases, including models that are designed for use with custom cooling systems.
4. be quiet!: be quiet! is a German company that produces a range of PC cases and related components. They offer a variety of back panels for different types of PC cases, including models that are designed for use with silent operation.

In addition to these companies, there are many other manufacturers that produce back panels for PC cases. These companies may produce the panels in-house or may outsource production to third-party manufacturers.

*Process of Manufacturing of pc case in NZXT's (Shenzen, China, a mecca of electronics manufacturing) factory[1]:

*This cylinder of green polyurethane polymer is being sliced to help with production. It's crucial to uniformly distribute the weight when pressing big metal items to prevent denting or sagging. The plastic spools aid in distributing pressure evenly while protecting the metal. A tiny sample of the chassis toolings that are kept in storage at the NZXT plant. The poly suspending bushes that were kept with them are visible. The toolings must be carefully kept between manufacturing runs since NZXT's product catalogue is too large for all of its shells to be produced at once. * A single case can take quite so many as 100 of them, and each one is a massive, accuracy slab of steel. In NZXT's plant, well over 1000 tools are kept in storage.

*A massive spool of steel is inserted into the a hydraulic press, that bends the sheet over case tooling to create the first few pieces of a part. It automatically pushes down about every 3 seconds.

*Every scrap of metal is being knocked out and is falling to the ground. The equipment seen in the previous image feeds metal via a tooling that is attached to a press.

*A mechanical arm takes a PC case panels and pushes it from one button to the next as a worker monitors above it out of view. Each press has a unique tooling setup on it to mould a distinct case component. You can tell it relates to the H440 by looking at the lettering on the tooling. Although these mechanical arms were employed on the assembly plant to transport elements among toolings, the majority of it was manually performed.

*The side panel from the previous image is displayed here on a different manually operated machine. With this one, pilot holes are drilled in preparation for installation. If you look closely, you can observe the drillbits emerging from the machine's base.

*Several stages of the production process include quality control. This is a production line check, where a worker removes a panel from a stacking and measurements it to make sure the tools correctly produced it. Each measuring must be accurate to within one millimetre.

Before assembling, holes are pre-drilled in a casing using a different machine. The Phantom 820 was the casing that was being produced in this circumstance.

- This series of case components has through several (possibly dozens) toolings; keep in mind that each distinct cut and bending was presumably performed by a different tooling along the road. They are arranged in a stack adjacent to the paint station; shortly, they will receive a coat of colour to bringing them to reality.

- **There are several economic factors that can impact the manufacturing of the back panel of a CPU** . These include:

1. 1. The price of raw equipment: The price of the plastic or metal components used to make the rear panel may exert a big influence on the total cost of manufacturing.
2. Labor costs: The cost of labor, including wages and benefits, can also impact the cost of manufacturing the back panel.
3. Production efficiency: The efficiency of the production process can also affect the cost of manufacturing the back panel. This includes the use of automation and the efficiency of the manufacturing equipment.
4. Demand for the product: The demand for CPUs and the back panel can also impact the cost of production. If demand is high, the cost of production may be higher due to increased demand for raw materials and labor.
5. Competition: The level of competition in the market can also impact the cost of manufacturing the back panel. If there is a lot of competition, manufacturers may need to lower their prices in order to remain competitive.
6. Government regulations: Government regulations, such as environmental regulations and import/export tariffs, can also impact the cost of manufacturing the back panel.
   Overall, the cost of manufacturing the back panel of a CPU is likely to be influenced by a combination of these economic factors.

- **Material utilization is an important factor to consider when manufacturing the back panel of a CPU**. It refers to the amount of raw material that is used to manufacture the back panel, and it can have a significant impact on the overall cost of production.
  There are several ways to optimize material utilization in the manufacturing of the back panel of a CPU, including:

1. Design for manufacturing: Carefully designing the back panel for manufacturing can help reduce the amount of raw material used. This can include designing parts to minimize waste, using thinner materials where possible, and optimizing the layout of parts on the back panel.
2. Automation: Automating certain parts of the manufacturing process can help reduce the amount of raw material used by reducing the need for labor and increasing production efficiency.
   Fast manufacturing: Improving material use may also be accomplished by putting lean manufacturing ideas into practise, such as cutting waste and optimising the production system.
   Overall, optimizing material utilization in the manufacturing of the back panel of a CPU can help reduce production costs and increase profitability.
   Regenerate response.

***Heating Problem:**

The back panel of a CPU (Central Processing Unit) can generate heat as a result of the operation of the CPU itself. The back panel acts as a heatsink, helping to dissipate the heat generated by the CPU to keep it from overheating.

There are several factors that can contribute to heating problems with the back panel of a CPU, including:

1. Insufficient cooling: If the back panel is not properly cooled, the heat generated by the CPU may not be dissipated effectively, leading to overheating. This can be caused by insufficient airflow or a malfunctioning cooling system.
2. High CPU load: If the CPU is running at a high load for an extended period of time, it can generate more heat, which can lead to overheating of the back panel.
3. Poorly designed back panel: If the back panel is poorly designed, it may not be able to effectively dissipate the heat generated by the CPU, leading to overheating.

To address heating problems with the back panel of a CPU, it may be necessary to improve the cooling system, reduce the load on the CPU, or redesign the back panel. In some cases, it may also be necessary to replace the back panel if it is damaged or not functioning properly.

*About previous back port panel:

Detailed information about Percentage utilization of material during manufacturing of back port panel is not available officially, But I have calculated manually by taking measurement using various measuring equipment and found that percentage of utilisation of material is less than 60% in most cases and those panel have greater than 60% utilisation of material haves less port slot in the panel.

*percentage of utilization of material is calculated by

*Percentage of utilization =

$$\frac{\text{Total Area of component x No. of rows x100}}{\text{Pitch *width of strip}}$$

CONCLUSION

*By considering all the aspect of manufacturing of panel of CPU, Methodology like Stamping, Punching, Laser cutting, Waterjet cutting, EDM (electric discharge machine) Most cost effective and easy to implement and very reliable to use methodology is using press tool.

* Percentage of utilization of material can be maximised by redesigning of ports positions so that the scarp or waste material can be minimised.

*For designing port panel use of progressive press tool is most convenient and cost effective comparing to other manufacturing process.

REFERENCES

[1] https://www.pcgamer.com/how-pc-cases-are-made-inside-nzxts-factory/
[2]https://www.tutorialspoint.com/computer_fundamentals/computer_ports.htm
[3]https://www.tutorialandexample.com/what-is-back-panel
[4]https://www.alamy.com/stock-photo/pc-back-panel.html?sortBy=relevant
[5]https://pranaysundarkar.blogspot.com/2017/10/study-of-front-panel-and-back-panel-of.html
[6]Progressive dies : principles and practices of design and construction.
Author: Dallas, Daniel B. Progressive dies.
ISBN: 9780872634480

Edition: Second edition
Publication Information: Dearborn, Mich. : Society of Manufacturing Engineers in cooperation with the Forming Technologies Association of SME, c1994.
[7] Techniques of pressworking sheet metal :an engineering approach to die design by Eary, Donald F; Reed, Edward A., author Passi
[8] Theory of Machines. Author :J. K. Gupta & R S Khurmi.
[9] **Tool Design** ; Authors, **Cyril Donaldson**, V. C. Goold ; Editor, George H.Le Cain ; Edition, illustrated, reprint ; Publisher, Tata McGraw-Hill, 1976.
[10] **Tool Design** ; Authors, **Cyril Donaldson**, V. C. Goold ; Editor, George H.Le Cain ; Edition, illustrated, reprint ; Publisher, Tata McGraw-Hill, 1976.
[10] **Advanced Diemaking Diemaking** Series. Author, **D**. **Eugene** Ostergaard. Contributors, National Tool, **Die** & Precision Machining Association.
[11] Westermann Tables for the Metal Trade ; Author: **Eduard Scharkus, Hermann Jutz** Production engineering by P.C. Sharma
[12] Die Design Fundamentals by J. R. Paquin; **Robert E Crowley**
[13] METROLOGY AND QUALITY CONTROL | **M M BHOOMKAR** , S G SHILWANT , S S KUBER , A M BADADHE.
[14] Data Book of Engineers by PSG **College-Kalaikathir Achchagam – Coimbatore**
[15] DESIGN AND ANALYSIS OF A SMALL FORM FACTOR DESKTOP COMPUTER ENCLOSURE by Curt Adkins, Morehead State University.
[16] https://blog.flipperzero.one/case-manufacturing/
Case manufacturing behind the scenes
[17] Niebel B. W. An analytical technique for the selection of manufacturing operations. *J. Ind. Engng*, 1966, 9 (11), 598–603.
[18] Dargie P. P., Parmeshwar K., Wilson W.R.D. MAPS-1: Computer-aided design system for preliminary material and manufacturing process selection. *Trans. ASME*, 1982, 104, 126–136.
[19] https://www.instructables.com/Designing-a-PC-Case-From-Scratch/
Designing a PC Case From Scratch for selection of material and design part.
[20] Sheet metal forming process & Die design
Author Vukota Boljanvic.