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Design Considerations in Wood and Metal Integration

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Abstract **- This research is a pragmatic approach to the definition of the comfort zones of wood and metals to ensure constructive designing. The researcher implemented a mixed approach of integrating both primary and secondary data of operations and circumstances surrounding wood and metal simultaneously. This entails observation of activities of relevant agencies coupled with content analysis of relevant documents. These were carefully analysed and tabulated leading to four domains under which design planning could be based. These are: the technologies involved, material forms, executable projects, and resulting by-products from the processing of both materials. It was realized that wood and metals have common items under the four fundamental domains that make an easy approach to integrating them when designing products.**

Keywords: Integration, design considerations, wood, metal, "woomeint"

INTRODUCTION

Wood and metal have a long tradition of being used together. From a Latin word (*integer*) meaning whole or entirety, integration during product development is a process in which separately produced components or subsystems are combined and problems within their interactions addressed. (TechTarget). This implies that integration is a result of unification of agreeing components or intended members for the achievement of a common predefined purpose. This is also the foundation upon which survival of the universe is based. The cycles of life are designed such that all things directly or indirectly affect one another in one way or the other in a perfect cycle that ensures the sustenance of the Earth. Therefore if perfection or the achievements of positive results become the ultimate goal of an endeavour, there is the need to make scrupulous investigation in order to combine not only relevant but agreeing information or resources into a sure constructive solution. This coalescing of agreeing resources relevant to the solution of a well defined problem is called integration, which is the basis of this paper. In this respect, this paper brings to the fore, a holistic approach to wood and metal integration and seeks to bring to bare the problems within their interaction in a "woomeint" (wood and metal integration) concept. In other words, it provides specific areas for which such interactive problems can be found to facilitate a more informed designing of a "woomeint" project.

Adam (2002) giving accounts of art, shows many ancient art works that are still in existence, the most surviving of which are in metals. In the context of wood the most surviving are those that are in conjunction or preserved with metals. In this respect, metals have lasting effects on woods. Some of these are: A Lyre soundbox from the tomb of Queen Puabi Ur. 2685 B.C. made of wood with some parts inlaid with gold and the head gilded or covered with gold sheets. Following this is a stag discovered in the 4th century B.C. This is fashioned in wood after which it is covered with gold, silver and bronze. Another example is an ancient mummy case made of wood and gold leafs bonded by stucco. There are also cases in which a wooden piece is made to look so metallic and precious. An example is the reliquary statue of Sainte Foy, 10th -11th century. It is made up of gold and gem stones over a wooden core. Careful study of these works among others revealed that the logistics, processes and outcomes are not too different from those wood and metal workers indulge in of late. The research question established to this effect therefore, is: What considerations should be made prior to conceptualising a wood and metal integrated design?

CONCEPT AND METHODS

Concept

This paper aims at ensuring that wood and metal integrated concepts for production undergo enough scrutiny to achieve least problems within the integration, if not a problem free result that would stand the test of time in terms of appropriate technology; materials forms; projects; material management and environmental safety.

Methods

With reference to the research question and the concept, relevant literature on the two materials were purposively and conveniently sampled and reviewed to ascertain technologies, material forms, projects and by-products that are comparable or common to production in both wood and metal. These comprise relevant books from libraries and other sources including processes in relevant wood and/or metal agencies. The sample sizes to this effect are elaborated in Table 1 and 2 respectively.

The content of the books were critically analysed in conjunction with observation of the activities of the relevant agencies. These constituted the primary and secondary data for the research. During this process, cognisance was taken of where the two materials come to

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terms with each other. This is because; it is upon such grounds that the two materials can be integrated more conveniently. These were therefore critically analysed, and grouped under four main strategic headings that include common technologies between wood and metal; common wood and metal forms; common products/projects of both material; and common by-products that could be integrated towards a holistic use of the materials to avoid waste.

Table 1: The sample of literature relevant to wood and metal integration

Wood		Metal	
Literature on the growth of tree and how they influence the resultant wood	2	Metal forms	2
Literature on structure, properties and usage of wood	2	Literature on structure, properties and usage of metal	2
Literature on usage of wood	5	Literature on metal production	5
Literature on general information on wood	1	Literature on general information on metal	1
Literature on finishing	2	Literature on finishing	2
Total	12	Total	12

Table 2: The sample of agencies that were visited during the research

Categories of agencies	Sample
Metals workshops,	10
Wood processing firms	1
Furniture and wood products firms	10
Others	5
Total	26

RESULTS AND DISCUSSION

Possibilities in wood have been discussed by many writers. Some of these writers include Chapman and Peace (2008), Simpson (2008), Emmitt and Gorse (2007), Oteng Amoako et al (2006), and Prisant (1999). Their accounts on the utilization of wood can be categorised into: processing and production. In terms with Untracht (1985) and others' regarding metalworking concepts and technology: wood and metal demostrate appreciable common grounds adaptable for constructive integration. Consequently, the activities outlined in the methodology resulted in an information bank for different purposes under the strategic headings as follows: Common Technologies between wood and metal, Common metal and wood forms, Common projects of wood and metal, and Common by-products.

COMMON TECHNOLOGIES BETWEEN WOOD AND METAL

With regards to the processing and production of the two materials, twenty-eight (28) technologies were identified under five (5) classifications. Though common to both materials, most of the time, they bear different terminologies in wood and metal respectively. These classifications are material engineering, forming, construction, decoration and finishing technologies. These are detailed in Table 3. The purpose of this consideration is to facilitate easy identification of processes of wood or metal that could invite the other. This is to aid the designer to make well informed decisions to ensure feasible "womeint" concepts.

Some of these common technologies are factors that facilitate the integration of both materials without much problem. This is so because the common technologies have direct link with common tools and materials that could be used to deal with both materials for effective time management and cost effectiveness.

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Table 3: Observed technologies employed in the industry

Category of technology	Technology	Metal terminology	Wood terminology
Material engineering	Grit bonding	Cold casting or fusion	Chip board casting
	Sheet bonding	Mokume	Ply bonding
	Strip or buttons bonding	Mokume	Lamination and kerfing
	Sponge making	Direct reduction	Beating
Forming	Lathing	Metal lathing	Wood lathing
	Chiselling	cold chiselling /carving	Chiselling/carving
	Heat forming	Forging	Hot bending or steam bending
	Casting	Hot and cold casting	Dust casting
	Shearing	Sheet shearing	Veneer shearing
	Sawing	Sawing /piercing	Sawing/coping
	Planing	Milling	Planing
	Filling	Filling	Rasping
	Drilling	Drilling	Drilling
Construction	Creation of joints	Jointing	Jointing
	Fastening of joints	Riveting, screwing and bolting.	Riveting, screwing and bolting.
	Adhering of surfaces	Cold bonding (e.g. Use of epoxies)	Gluing (e.g. Use of PVA)
	Mechanising	E.g. Hinging	E.g. Hinging
Decoration	Texturing	Matting or stamping	Stamping /texturing
	Sheet laying	Gilding	Lamination
	Reliefing	Engraving, embossing/repoussé	Engraving, intaglio, and embossing
	Colouring	Painting, incision and heat colouring	Painting, incision and heat colouring
	Hole sawing	Piercing	Coping
	Heat colouring	Oxidation	Scorching
Finishing	Buffing	Mechanical and hand buffing with polishing compounds	Mechanical and hand buffing with polishing compounds
	Painting	Brushing and spraying	Brushing and spraying
	Abrading	Scraping and abrasion	Scraping and abrasion
	Varnishing	Clear finishing	Clear finishing

COMMON METAL AND WOOD FORMS

Bridgewater A. and Bridgewater G. (2007) opine that selecting solid wood is exciting, but one must avoid making expensive mistakes, such as: choosing the wrong type of wood, or a poor quality wood. One of the best ways they mentioned for ensuring that one finishes up with good wood that is fit for its purpose is to know something about conversion. Bray (2003) capture some of the many forms of metals that result also from metal conversion (Tracy, 1971). These respective processing of the materials put them in variety of forms suitable for different purposes. Some of which are purposeful and others are by-products. Under this, four (4) groups of similarities were identified between wood and metal. These are flat forms, bars, fibres and particles/dust as spelt out in Table 4.

The role of these in "woomeint" is that, they are strong determinants of the types of projects that can be actualised in wood and metal integration. It will also suggest common roles both materials can perform notwithstanding common projects.

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Table 4: Common metal and wood forms identified

Type of form	Metal terminology	Wood terminology
Flat forms	Sheet	Veneer
	Plate	Slicer boards and engineered boards
	Strip	Strip
Bars	Rods (hexagonal, square, rectangular and round) of various sizes	Poles, buttons, beams and wood mouldings of various sizes.
Fibre	Steel wool/DRI (Direct Reduced Iron)	Wooden fibre sponge
Particles / dust	metal dust /powder	Wood dust
	Metal chippings	Wood chippings

COMMON PROJECTS OF WOOD AND METAL

Bridgewater A. and Bridgewater G. (2007), narrate that wood is probably the most versatile of all materials, due to the fact that it is easily cut and shaped; incredibly strong and available in hundreds of colours, texture and grain patterns. It also shows differently each time it is cut and everyone seems to like the warm rich natural texture of wood. Coupled with the evidence of metal versatility in our environment, this suggests that both materials are almost endless in their application. Consequently, nineteen (19) similarities were identified under six (6) categories. These are: containers, furniture, demarcations, room accessories, decorations, clothing and accessories as spelt out in Table 5. The availability of the same kind of articles in both areas are enough motivation and clue towards the merging of the two materials in the same or similar products. This could also serve as a basis for the development of other products subsequently or simultaneously.

Tables 5: Observed common products of wood and metal

Type	Metal	Wood
container	Trunk	Chop box
	Purse	Purse
	Jewellery box	Jewellery box
	Trays	Trays
	Handbag	Handbag
Furniture	Cabinet and shelves	Cabinets and shelves
	Chairs, stools and tables	Chairs, stools and tables
	Doors and gates	Doors and gates
Demarcations	Fence	Fence
	Partition	Partition
	Bars	Bars
Room accessories	Blinds	Blinds
	Vases	Vases
	Candle and lamp stands	Candle and lamp stands
Decorations	Frames (for pictures and mirrors)	Frames (for pictures and mirrors)
	Sculpture (in the round and reliefs)	Sculpture (in the round and reliefs)
Clothing and accessories	Fasteners	Fasteners
	Jewelleries	Jewelleries
	Belts	Belts

COMMON BY-PRODUCTS

Per the accounts of the relevant literature and observation, it was identified that the by-products of the activities involved in the processing of the respective materials are similar. These result from both similar and different processes between wood and metal. Identified are: dusts, shaves, grits, chipping and off cuts of both wood and metal outlined in Table 6. These are relevant in many ways depending on the creative discretion of the user. With reference to technologies involved in the reuse and recycling of the by-products of both materials, the idea of these by-products could lead to integrated composites or materials for creative “woomeint” products.

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Table 6: Similarities in wood and metal by-products

By-products	Dust	Shaves	Grits	Chippings	Off cuts
In metalwork	From abrasion	From lathing	From sawing, grinding and filling.	From Drilling, shearing and milling	From sawing and piercing
In woodwork	From abrasion	From planing	From sawing and rasping	From drilling and shearing	From sawing and copping

CONCLUSION

Wood and metal are both versatile materials that are different and similar. This is so because they differ in certain functions and applications but are similar in other functions and applications. The advantage of one over the other depends on the intention of the worker, the nature of the wood and the metal at hand, and thirdly the project to be undertaken. Methods of integrating wood and metal involve the individual methods of production of the two materials and other superior methods that may be necessitated by the integration of both materials.

Factors that affect the nature of wood and metal integration depend more on the wood conversion and processing method than on metal. This is so because metal can easily be reorganised or recycled into any form that becomes necessary, contrary to wood. This makes wood a dictating factor in “woomeint”.

Also, unlike wood technologies that rarely achieve their desired effects on metals, the metal technologies need little or no improvement to service the “woomeint” paradigm. These are evident in the processing, forming, construction, decoration and finishing of wood and metal integrated works.

Moreover, structural failure may be dependent more on wood than metal due to its nature. The anisotropic nature of wood species based on their internal factors (example, structural formation and growth deformities) and external factors like variation in environmental and weather conditions among other chemical sources like acid rain. Therefore, definition of form in wood and metal integration is such that, metals can easily be adopted; however more attention is needed in considering the appropriate wood form.

This paper also concludes that, the common projects identified suggest a limitless scope regarding wood and metal integrated projects. Also the good similarities in respective by-products that are already reusable are good premise for effective material management through complete usage of materials in the integration.

RECOMMENDATION

Wood and metal have the tendency of affecting the environment and the user for that matter. It effects are both positive and negative. It is therefore recommended that, user related issues as well as environmental issues be the underlying principle upon which the four fundamental design considerations should be based.

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