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Exploring the Relationships Between Material and Image in the Exquisite Graphics of Letterpress Printing †

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Abstract

This current scientific article deals with the study of the relationships between material and iconic image in fine graphics. In this specific case, these relationships relate only to letterpress printing. Of interest are non-standard materials, which, depending on their physical and chemical indicators, lead to different results in the final artistic image. The aim of the article is to establish the dependencies: material–manipulation–result–effect/defect. Specific "effects" are sought in the final version of the image, in which the work of fine art-graphics is of high artistic value. For this purpose, experiments were conducted with the same images, but on different material carriers, with different inks and types of paper, which practically establish the physical and technological indicators and results. From these conditions it is established what artistic effect or defect is realized. The parameters presented in the comparative tables are intended to orient the user as to what base, ink and paper to choose for a specific creative manifestation.

Keywords: fine graphics; letterpress; artistic image; material

1. Introduction

For images related to art [1], it is difficult to say and even more so to prove when a result is successful and when it is not. There are many conditions for objective assessment, since the most important thing for a "correct" assessment of the result is the message as the ultimate goal of the author. Beauty is not a condition for success, except when this is not sought, because art also deals with categories of ethics and esthetics. In the present case, we will examine the materials in the classical technique of fine graphics related to letterpress printing. The experiments will establish certain conditions and interrelationships between the possible materials used, applicable in drawing classes at different educational levels. The subject Art Techniques, in the Engineering Design specialty at the Technical University of Sofia, is committed to the mastery of various visual techniques through the use of different visual materials [2].

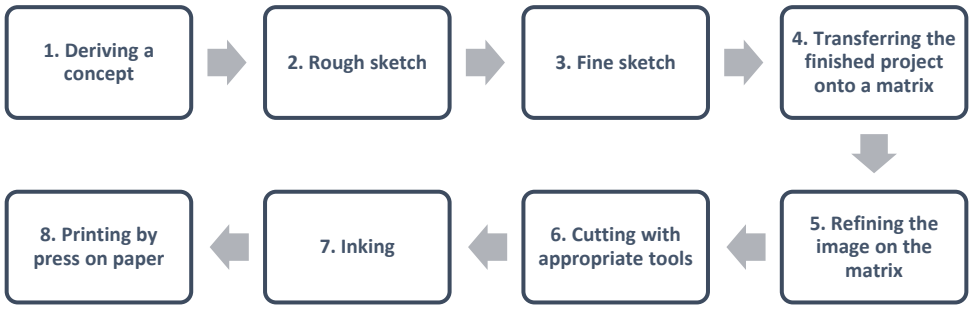
The technological process of a graphic image is long, complex and in this sense multi-volume and multi-extensive. This is a good reason to prove the dependencies in the material processes of each of the stages through which the graphic artistic process passes. The materials used are different, starting from the initial conceptual sketches, the transformation of the idea into a project, the transfer of the project onto a matrix base, the choice of ink and the methods of inking, the choice of suitable cardboard and printing. Scheme 1 shows the stages of making a letterpress.

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Scheme 1. Workflow stages.

Graphics as a visual technique is specifically fine art, in which the main means of expression are the line, the spot, the stroke and their combination. The choice of means of expression is sought mainly because of the balance of black and white, through which balance the conceptual compositional design is expressed. The possibility for color graphics is not the goal of graphic techniques in general nor in particular of the present study.

Terminologically, people who are not closely involved with this technique professionally use "graphics" to refer to all images that are the result of the main known temporary black graphite materials such as ink, pencils, chalks, charcoals, etc. However, graphics only refers to images that are the result of a reprint from a previously prepared matrix and when this image allows it to be replicated. The number of replicated copies with high artistic value is strictly dependent on the material carrier of the matrix. Some graphic techniques such as etching, for example, allow all printed copies to have high artistic value according to technical indicators, since the metal plate, if it is zinc, has undergone acid treatment, which fixes the used pictorial and artistic patterns. Unlike etching, dry point can use the same technical techniques in its work, but when printing, when the matrix is from the same metal carrier as the etching, a maximum of ten images of similar quality can be obtained. In dry point, with each subsequent print, the concave areas are smoothed and erased under the strong pressure of the press, and deformations occur in the matrix. This example is intended to draw attention to how important the material is in which the design is made.

2. Overview

The graphic technique originated in China and Japan, where as early as the 9th century wooden bases were used to print texts and images. In Europe in the 14th–15th centuries with the advent of xylography (woodcut), the reprints were initially used for religious images. Examples of this are the printed illustrations in liturgical manuscripts.

The invention of the printing press by Gutenberg in 1440 was a key moment in the birth of reprinting, a process that accelerated the mass production of images and text. Copperplate engraving developed in Germany and Italy, with key figures historically being artists and inventors such as Martin Schongauer, one of the founding masters of copperplate engraving, and Albrecht Dürer, who perfected woodcuts and etchings by combining printmaking and Renaissance painting. Andrea Mantegna was a pioneer in Italian engraving.

The 16th–17th centuries were the heyday of fine graphics, when graphics were established as an independent art and techniques such as etching, dry point, aquatint, and mezzotint were introduced. Authors such as Rembrandt van Rijn, Jacques Callot, and Hendrik Goltzius belonged to this time. The 18th–19th centuries saw the emergence of lithography, associated with the name of Alois Senefelder in 1796. Other notable names during this period were Francisco Goya, Honoré Daumier, and William Hogarth.

In the 20th century, the graphic technique was a means of experiment and personal authorial style as a subject and as a technique. Graphics were established in modernism,

expressionism and abstraction, with the most famous names being the Norwegian author Edvard Munch, who experimented with the technique of woodcut by demonstrating emotional expression in engraving. The famous Spanish genius Pablo Picasso worked mainly with the technique of lithography, and among his works are the techniques of etching and linocut. Ernst Ludwig Kirchner, a German expressionist, played a strong role in the graphic language. Käthe Kollwitz is known for socially engaged etchings, lithographs and woodcuts.

Graphics in our time leave the boundaries of the standard established expressive and pictorial means, and for this it is influenced by the new materials to which there is free access and which allow experiments with graphic techniques in a less complexly equipped environment. Graphic techniques are becoming more accessible in non-professional environments, studios and workshops. Contemporary graphics can be defined as conceptual, considering mixed techniques, in which digital graphics are combined in installations with included graphic mechanical elements. In this new type of art, a response is mainly sought from the audience by encoding certain messages. Here it is emphasized again that graphicity is a way of expression through the balance of white and black, which in modern material conditions gives a different view of the concept-graphics.

Contemporary authors have made contributions to the theory and practice of the interaction between material and image and the classification of media and structure [3].

The physical dependencies of the printing process are clarified in terms of viscosity and penetration, from which new artistic approaches emerge through integrated techniques, combined technologies, and the compatibility of materials, density, and pressure [4,5].

Assoc. Prof. Dr. Snezhina Biserova shares: "There will be a return to classical graphic techniques..."—the time for a return to traditional graphics, as well as the development of non-toxic methods such as siligraphy (a waterless method of surface printing) [6]. She reports her results in articles from exhibitions and practices and in hybrid art formats by combining traditional techniques and experimental materials [7].

The book *Siligraphy—A Waterless Method for Surface Printing* (2007) describes in detail the non-toxic technique, its advantages and possibilities for quality and functionality in artistic printing [8].

Biserova introduced and popularized siligraphy in Bulgaria, emphasizing ecological, non-toxic materials and waterless techniques (lithography) particularly suited to precision in the graphic line. Her role in art education and curatorship of exhibitions such as "Graphic Transformations II" shows treatments of hybrid techniques with an emphasis on the interaction of material–carrier–ink.

Another Bulgarian author, Petar Lazarov, skillfully combines traditional woodcut with influences from Chinese techniques. He uses relief wood, cherry, and ink drawings that set a nuance in the absorption and granulation of the ink. He explores the natural structure of wood as a medium and integrates it into the compositional approach, proving that the natural material actively influences the image [9].

Dimo Kolibarov, another well-known graphic artist, works primarily through etching and aquatint on copperplates and lithographic substrates, using layering of images and techniques in his compositions. His technique is precise in the absorption of ink with attention to depth nuances—important in studying ink-to-paper relationships and parameters such as penetration and drying [10].

This article deals with the study of the relationships between materials and images in letterpress printing. Unlike letterpress printing, in which the image is extracted from depth using black ink on pre-moistened paper, in letterpress printing the image is removed from the high raised parts of the base onto dry paper.

From the brief retrospective review of contemporary scholars and artists thus made, it can be concluded that fine graphics as a process is expressed in dependencies between art, technique, technology and material means and, last but not least, individual expression in personal handwriting and the search for feedback through communication. From Dürer's engravings to Warhol's serigraphs, it has developed its own means of expression that continue to inspire today.

3. Technological Process

- The image is created indirectly through a prepared matrix, from which it is then reprinted.
- The process is always associated with the reproduction of the prints.
- The main means of expression are contrast, stroke, tonality and texture, compositional balance between black and white, line, spot and combinations of all of them.
- Printing can be done manually or mechanically depending on the technique used.
- Various materials can serve as a base—metal, wood, linoleum, polymer plates, paper, fiberboard, Komatex, etc.
- The tools used are needles, cutters, acids, rollers, and presses.
- The creation of a graphic image requires time for engraving, printing and drying.

Letterpress is a graphic technique in which the raised parts of the surface of the matrix retain the ink and are printed on the paper, while the depressions remain white. The main professional materials currently used are based on linoleum. This is where the name of the technique comes from—linocut, and for short, lino. In the beginning, when wooden boards were used as a base, the technique was called woodcut, also named after the material base for making the matrix. In any case, these are the possible known traditional bases that allow an impression to be taken from the surface, i.e., from the raised parts, which are the carriers of the black.

The technique of letterpress printing [11] is not only applied in art; rather, art borrows this principle of reprinting for its creative pursuits and messages, adapting the pictorial techniques that allow the best way to obtain the well-known effect of traditional lino. For example, in letterpress printing, metal or wooden letters and a printing press are used. The tools in this case are metal/wooden type blocks. Modern relief printing uses photopolymer plates, laser cutting and digital processes.

In this case, in addition to the well-known material linoleum for linocuts, the most viable and accessible bases are of interest, which, depending on their physiological and chemical characteristics, allow for certain results in the current problem. In any case, one or more results in the final image are either good or not, solely depending on the idea and the author's searches. But when it comes to educational works, then strict standard criteria are applied to determine the quality, purity of the lines and all expressive means used to express the image, uniformity of the stain depending on the type of ink and the method of inking, and the uniform absorption of the ink by the paper.

3.1. Materials for Making the Matrix (Bases)

- A classic base for woodcut uses wood such as beech, pear, and linden.
- Linoleum is more elastic, which makes it more suitable for smooth fine lines and transitions. There are different types of linoleum on the market, with only one type specifically designed for the letterpress technique. This type of professional linoleum formed on a jute fiber is sold in art supply stores. It is externally distinguished by the fact that the back of the base is lined with burlap. Other types of linoleum are produced and used for flooring, and depending on certain indicators, some of them also turn out to be quite suitable for performing this technique. Hard linoleums for

flooring are a good base. All qualities are yet to be correctly and specifically described and compared.

- Rubber/photopolymer is used in modern techniques (flexo printing) [12].
- Metal is used in typography for casting letters and ornaments, etc., whose qualities will be discussed below from the process of making the matrix.

3.2. Types of Papers Used in Letterpress Printing

Paper is critically important for the quality of the print. It is selected according to the technique and the desired texture. Table 1 lists different types of paper with their respective characteristics and usability.

Table 1. Paper characteristics.

Paper Type	Features	Suitable for
Japanese paper (washi, Hosho, Kozo).	Lightweight, strong, handmade, long-fiber.	Woodcut, fine linocut.
Etching paper—cardstock or thin.	Soft, absorbent, smooth.	All graphic techniques.
Machine-made graphic paper.	Affordable, different thicknesses.	Student and experimental projects.
Handmade cotton paper.	High durability, texture.	Collector's prints.

3.3. Letterpress Inks

So far, a limited number of inks are known and used.

- Oil-based ink is thick and long-lasting. The result is a bright and deep print. This type of ink is preferred for classical graphics. It is toxic, and it is difficult to clean the bases after finishing work. Oil paint is successfully used for painting and such attempts will be made.
- Water-based inks dry faster, and are less toxic, which makes them suitable and preferred for work with students, as they can be printed without a press.
- Flexo inks are used for industrial relief printing. They are characterized by low viscosity and dry quickly. It is used in the packaging and labeling industry [12].
- Oil paint—thickened with Wienerweiss—is used for educational works and in this report, this is one of the inks with which experiments are made, since it is non-toxic, and it is easier to clean even with warm water and soap, producing the dense and deep effect of professional oil inks.

3.4. Artistic Features of Letterpress Printing

- It is characterized by a strong graphic contrast, generated by the interaction and balance of the black and white effect.
- Traces of cutting, rubbing, and various forms of violation of the integrity of the base as a principle remain visible.
- The technique allows for rhythmic, modular repetition of shapes and images.
- Depending on the material carrier of the matrix, the image acquires a different character—decorative, modular, naturalistic and a combination of them.

Letterpress is a technique with deep historical roots and a rich visual language that has adapted over time—from classic woodcuts to contemporary polymer forms. It offers strong contrast, a hand-me-down feel and material depth that make it a favorite of graphic artists and designers to this day.

4. Material and Image Dependencies

4.1. Theoretical Statement

Letterpress can be interpreted as a controlled deformation of a porous medium, in which the artistic result is a direct function of the applied force.

Pressure and deformation are the key physical mechanisms by which:

- The relief of the matrix is "read" by the paper.
- The ink is transferred and fixed.
- The visual image acquires its material specificity.

Conceptual structured analytical proposals have been formulated in which pressure and deformation are directly related to specific letterpress materials. Tables 2 and 3 present specific parameters of the matrix and paper materials, which are a starting point for subsequent experiments.

Table 2. Paper–elasticity–allowable deformation.

Paper Type	Thickness	Recommended Deformation
Handmade (cotton)	0.3–0.6 mm	High (up to ≈8–10%)
Cotton (etching)	0.25–0.4 mm	Medium (≈5–8%)
Japanese	0.1–0.25 mm	Low (≈3–5%)
Industrial	0.15–0.3 mm	Low (≈2–4%)

Table 3. Matrix–pressure–deformation.

Engraving Material	Recommended Pressure	Paper Deformation	Risk of Overfilling
Wood (longitudinal cut)	Medium → high (≈0.4–0.7 MPa)	High	Line breakdown
Wood (cross cut)	Medium (≈0.3–0.5 MPa)	Medium	Loss of fine detail
Fiberboard	Low → medium (≈0.2–0.4 MPa)	Increasing	Matrix wear
Linoleum	Low → medium (≈0.15–0.35 MPa)	Low	Part filling
Cardboard for engraving	Low (≈0.1–0.25 MPa)	Medium	Relief crushing
Polymer	Low → medium (≈0.15–0.4 MPa)	Low	Minimal

Conditional designations in Table 3:

- Low = suitable for hand printing.
- Medium = standard press/even pressure.
- High = strong press/risk of deformation.

The numerical ranges are conditional and serve as comparative guidelines, allowing analysis of the relationships between pressure, deformation and the visual result in artistic letterpress printing.

Theoretical dependencies will be observed through practical implementation, which involves creating a letterpress graphic.

4.2. Experimental Methodology

The experiment consists of the following stages:

1. **Preparation of the matrix**

- The following base materials were selected: cardboard for engraving, fiberboard and plywood, two of the three types of linoleum—hard for flooring and linoleum, and polymer—and a type of Komatex, which were all obtained from commercial suppliers

in Sofia, Bulgaria (including Tuplex EOOD, JAF Bulgaria, and Factor.BG); the third type of linoleum, professional based on jute fiber, was produced by ABIG (Art Business Industrial Group GmbH, Nagold, Germany) and purchased from Art Service (Art Service EOOD, Sofia, Bulgaria).

- The following printing paper was selected: thin offset and regular smooth cardboard 100 g were obtained from commercial paper distributors in Sofia, Bulgaria (including Antalis Bulgaria and Europapier Bulgaria), and cotton professional paper for graphic prints was produced by Hahnemühle FineArt GmbH (Dassel, Germany) and purchased from Art Service (Art Service EOOD, Sofia, Bulgaria).
- Inks—water-based linoprint inks (Creall Lino; Havo BV, Almelo, Netherlands) and oil-based black paints (Sonnet; Nevskaya Palitra, Saint Petersburg, Russia), both purchased from commercial art suppliers in Sofia, Bulgaria.
- Oil paint thickened with Wienerweiss (produced by Kremer Pigmente GmbH & Co. KG (Aichstetten, Germany) and purchased from Art Service (Art Service EOOD, Sofia, Bulgaria)).
- The linocutters used for carving the blocks consisted of a 5-piece set with a wooden handle produced by ABIG (Art Business Industrial Group GmbH, Nagold, Germany) and purchased from Slanchogled (Slanchogled Ltd., Sofia, Bulgaria).
- The following design compositions for printing (Figure 1) were created:



(**a**) (**b**) (**c**)

Figure 1. (**a**–**c**) Conceptual sketches by Mihaela Gadzheva-Nedelcheva.

The above images are abstract compositions measuring 90/100 mm, which will be made on the indicated bases and printed on different papers. Each of the images was created with a specific purpose.

Figure 1a is a composition of straight parallel and intersecting lines of varying width. This type of image aims to explore how different engraving bases allow for image clarity by allowing for a clear outline of the image and variability in the line relative to the size of the areas, and the clear and legible cutting directions.

Figure 1b is a composition of complex details that are different in size and shape, the result of the intersection, detection and overlap of geometric circles, straight lines and broken lines. This variant provides an investigation of the direction when cutting the material and the purity of the printing in the image. The project serves as a balanced variant of spots and shapes, not aiming for exact replication in all variants, but giving a reason and occasion to test the structure of each individual material for a matrix—is it possible to cut in all directions?

Figure 1c is a composition made up of strokes/lines of different thicknesses that intersect depending on the image. The study will show which materials, depending on their structure and chemical composition, allow such manipulation and with which tools manipulation is possible.

2. Implementation: stages of work

- The already approved drawing project should be transferred (Figure 2) onto the engraving material, which in this case is done using indigo. When transferring the image, it was found that the rubber base did not retain the line from the indigo due to its specific smooth structure.
- Cutting work (Figure 3)—all the bases chosen for the experiment are worked with the same engraving tools—quality cutters that are easily available in art supply stores.

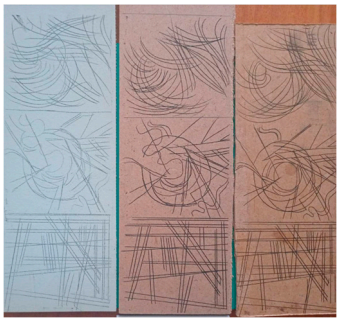
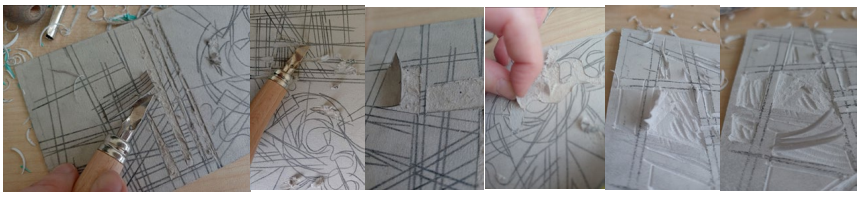


Figure 2. Matrix preparation.



Figure 3. Engraving materials from left to right: Komatex, regular hard linoleum, paper, fiberboard.

- Mechanical processing of cardboard (Figure 4): This material is used in the classroom to cut out parts of an image according to previously prepared patterns. The resulting pieces of cardboard are collaged onto a base of the same material with glue [11]. The image thus prepared is inked and printed. Experience shows that when this matrix of collaged cardboard is inked for the first time, it is "sealed" and does not fray during subsequent prints. In the present experiment, as can be seen from the images of the cutting process, cardboard is almost impossible to engrave. Although it appears to be a hard material, when engraving is required it turns out to be soft and fibrous, which does not allow cutting. Cutting is permissible only with a tool that looks like a knife and mainly performs the function of cutting. While cutting along the contours of the image, the excess is peeled off. Experience shows that this is the only possibility for manipulating the cardboard material.



(**a**) (**b**) (**c**) (**d**) (**e**) (**f**)

Figure 4. (**a**–**f**) Cardboard engraving.

- Mechanical processing of fiberboard (Figure 5): This allows engraving in all directions and with all cutter numbers. With cutter No. 1, the line is dirty and unclear and without a problem this tool cannot be used. Particleboard is basically a material made of pressed uniform wood particles, which does not imply a direction of movement of a given structure. It is used for the back of furniture, drawer bottoms, models and teaching models, pads, interior panels, and as a base for drawing and graphics. It can be treated only on one side, which is smooth.



(**a**) (**b**) (**c**)

Figure 5. (**a**–**c**) Fiberboard engraving.

- Mechanical processing of plywood: Plywood is a layered wood composite material made of thin sheets of veneer glued crosswise at 90 degrees. Its composition can be considered materially, structurally and chemically. The outer layers determine the appearance, surface quality and some of the mechanical properties. It is characterized by high strength at low thickness, resistance to cracking, and good workability (cutting, drilling, bending during steam treatment). It can be treated on both sides. Interestingly, one side provides a cleaner and clearer contour when cutting, while the other is more fibrous and not so clearly legible. A pleasant and easy-to-work-with material, it allows for quick production, does not cause the hands to become strained, and is easy to control when cutting. It is suitable for educational and artistic decorative images in large-scale compositions [11]. Following the example of cardboard, it allows cutting with the flat cutting blade, thus ensuring that larger pieces peel at the same time. It is similar in construction and in its final version to the fiberboard.
- Mechanical processing of Komatex: Komatex is the name of a foamed rigid PVC sheet (PVC foam board). It is used in advertising, design, interior architecture, exhibition design and construction. It is characterized by low density; is lightweight; has good bending strength; and is waterproof, chemically resistant, non-corrosive, a good electrical insulator, and flame retardant. The material is also found under other names depending on the manufacturer but is basically foamed PVC. Different types differ in density and hardness.
- Mechanical processing of linoleum: Linoleum is a floor covering, the composition of which depends on whether it is classic (natural) linoleum or modern PVC linoleum. In practice, they are often confused. Classic linoleum has a complex structure based on linseed oil, which will be discussed in the next paragraph; here we examine the modern version. A hard and at the same time plastic material for engraving, it provides a precise and fine-detailed result. It is difficult to work with due to its hardness, but is cheap and available on the market. Its specific hardness limits complex engraving and virtuosity in hand movements with engraving tools—the hand slips easily due to its slippery, hard nature.
- Mechanically processed professional linoleum on jute threads is the classic natural linoleum used in public buildings, schools, museums and hospitals. Unlike ordinary linoleum, it is hard but airy, with a pleasant structure built on a base of linseed oil. This is exactly the version of linoleum used by professional graphic artists for letterpress

printing. It provides full-fledged work with all numbers and variants of the cutters. It is easy to work with accurately and precisely. In the case of images, the results are predictable and expected. There is full control over the production. For educational works of a more decorative nature, it is meaningless because in this case it is expensive and difficult to produce. In this sense, depending on the project, another more suitable material can be selected. This is the main reason for the research in this work—namely, depending on the project, what materials should be selected in order to achieve the most successful artistic result. This type of linoleum allows the production of images with high nuances of light and shade, which is impossible with the other materials listed here and tested in practice. Komatex and ordinary linoleum in general can reach certain values, but not in extremely desirable and sought-after results specifically in nuances.

- Mechanical processing of vinyl: Vinyl is a multilayer synthetic PVC material containing plasticizers, fillers and stabilizers, intended for floor loads, but with limited artistic value for a graphic matrix. It is too soft to allow any treatments or cuts, which is observed in the experiment. The only tool with which any trace is permissible is cutter No. 2 and only in a straight line. It is difficult to achieve crossing and this can only be achieved in two directions with straight strokes; the condition for this is that they are sufficiently distant from each other, as can be seen from the experiment in Figure 6 with linoleum. It is definitely an unsuitable material; it is impossible to cut due to its excessive softness, so it is crushed and not cut. It could be used for a collage of details and on this basis to think about a composition, but when printing we will observe how it tolerates pressure and whether it is suitable according to the example of pressed cardboard.



Figure 6. Vinyl engraving.

- Mechanical processing of rubber (Figure 7): This has a uniform structure, plastic and soft, but allows for precise marking. It is extremely easy and pleasant to work with.



Figure 7. Matrices. From left to right: linoleum, cardboard, linoleum formed on a jute fiber, fiberboard, Komatex, vinyl, plywood, rubber.

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3. Printing

Inking of the various substrates is shown in Figure 8, bonding the ink to the surface of the substrate.

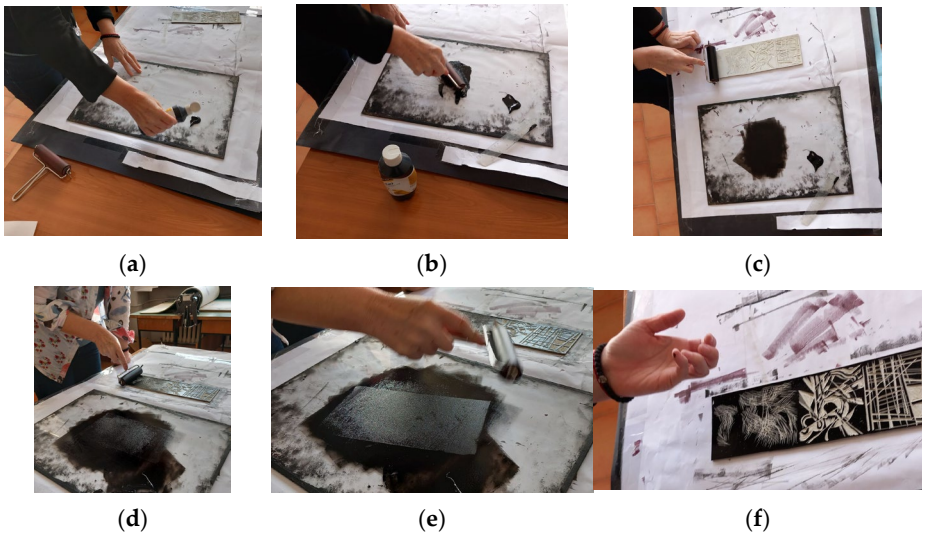


Figure 8. (**a**–**f**) Stages of the foundation inking workflow.

When inking, the quantity and quality of the ink is monitored—thin, numerous layers, each subsequent layer intersecting. The ink is applied with one forward movement of the roller and is thus placed on the base.

Figure 9 shows the printing process with a non-professional graphic press. The prints were executed using a custom-built manual etching press available at the educational studio of the Department of Engineering Design at the Technical University of Sofia (Sofia, Bulgaria); the press was designed and constructed by Assoc. Prof. Dr. Georgi Chervendinev, the former head of the department.

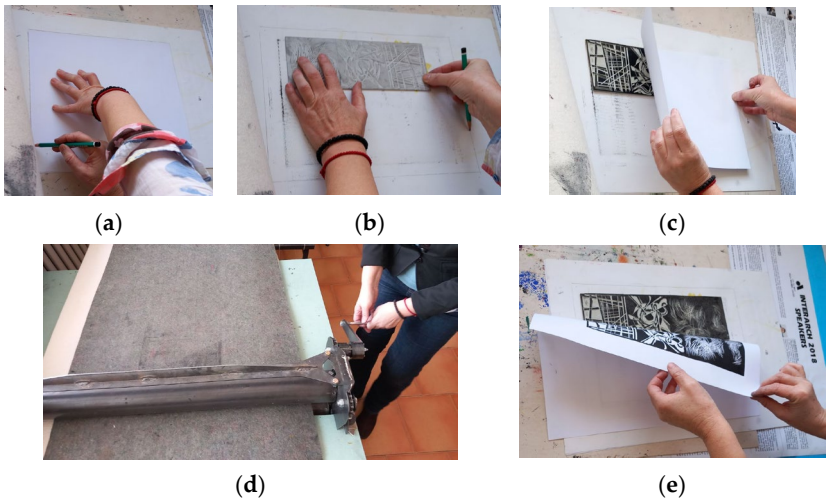


Figure 9. The printing process. (**a**) Sizing, (**b**) positioning, (**c**) paper loading, (**d**) the press, (**e**) result check.

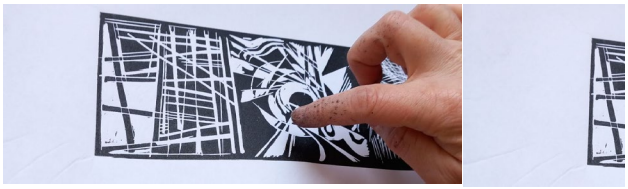
All experiments are performed using the same methodology. Each new experiment is recorded (Figure 10) and compared with the previous ones.

Experiments show that the thinner the paper, the greater the deformation and relief (Figure 11). Thick and cotton paper does not deform with any of the matrix bases.

The conclusion that follows from practical observation is that, depending on the thickness and composition of the paper, different shapes, locations, deformations and reliefs are obtained in the print.



Figure 10. Documenting the results.



(**a**) (**b**)

Figure 11. (**a**,**b**) Printing defects.

Glossy paper, due to its shiny and smooth surface when printed with water-based ink, spreads to the sides of the engraved image—there is no absorption of moisture from the ink (Figure 12), like there is with other papers, and therefore the image looks "out of focus". The conclusion is that poor letterpress paper spreads the image and causes severe deformation around the corners of the base due to the lack of plasticity—it is smooth and hard, although it is thin.

Kraft paper makes a good impression (Figure 13), but it deforms at the edges of the matrix base.



(**a**) (**b**)

Figure 12. (**a**,**b**) Printing defects on glossy paper.



(**a**) (**b**)

Figure 13. (**a**,**b**) Printing defects on kraft paper.

The results shown below in Figure 14 from experiments on the graphics from the letterpress, are numerous due to the combination of different types of papers, inks and matrices.



Figure 14. Experiments—matrix substrates and paper outcomes. From left to right: (**a**) ordinary linoleum matrix printed on kraft paper and album cardboard using water-based ink; Komatex matrix, (**b**) professional linoleum matrix based on jute fiber printed on large kraft cardboard paper using water-based ink; Komatex matrix configuration; (**c**) rubber matrix printed on thin offset paper; ordinary linoleum matrix printed with a mixture of oil-based paint and Wienerweiss on offset paper; (**d**) fiberboard matrix printed with a mixture of oil-based paint and Wienerweiss on glossy paper; cardboard matrix configuration printed on triple-gloss paper; (**e**) ordinary ink mixed with Wienerweiss printed on offset cardboard paper; (**f**) vinyl (hard flooring linoleum) matrix printed on offset paper; fiberboard matrix printed on offset paper; (**g**) cardboard matrix, rubber matrix configuration printed on offset cardboard paper; (**h**) pressed cardboard matrix printed with a mixture

of oil-based paint and Wienerweiss on offset cardboard paper; (**i**) professional linoleum matrix based on jute fiber printed on a glossy paper substrate using water-based ink; Komatex matrix configuration; (**j**) ordinary linoleum matrix printed on offset cardboard paper using water-based ink; Komatex matrix configuration printed on offset paper; (**k**) ordinary linoleum matrix carved with rounded linocutters and printed on 100% cotton paper using water-based ink; Komatex matrix configuration printed on cotton paper; (**l**) ordinary linoleum matrix printed on thin glossy paper using water-based ink; Komatex matrix configuration; (**m**) ordinary linoleum matrix printed on offset paper with water-based ink; modified configuration printed using a mixture of oil-based paint and Wienerweiss; (**n**) ordinary linoleum matrix printed on 100% cotton paper using water-based ink; (**o**) vinyl (hard flooring linoleum) matrix printed with a mixture of oil-based paint and Wienerweiss on offset cardboard paper, cardboard matrix printed using a mixture of oil-based paint and Wienerweiss; (**p**) ordinary linoleum matrix carved with rounded linocutters and printed on offset cardboard paper with polymer ink; modified configuration printed using a mixture of water-based ink and Wienerweiss; (**q**) Komatex matrix printed with a mixture of oil-based paint and Wienerweiss on offset cardboard paper; rubber matrix printed with a mixture of oil-based paint and Wienerweiss on offset cardboard paper; (**r**) rubber matrix configuration printed on cardboard and thin offset paper; (**s**) fiberboard matrix configuration printed on glossy paper; (**t**) ordinary linoleum matrix printed on offset cardboard paper with water-based ink; identical matrix and substrate configuration but executed using an ink formulation modified with Wienerweiss; (**u**) ordinary linoleum matrix printed on thin offset paper using water-based ink; Komatex matrix configuration, demonstrating the most severe structural deformation on the paper substrate during the printing process; (**v**) ordinary linoleum matrix printed on thin offset paper using water-based ink; fiberboard matrix configuration; (**w**) Komatex matrix configuration printed on thin offset graphic paper using a mixture of oil-based paint and Wienerweiss; fiberboard matrix printed on thin offset paper using a mixture of oil-based paint and Wienerweiss; (**x**) ordinary linoleum matrix printed on offset cardboard paper; identical matrix and substrate configuration but executed using black ink mixed with Wienerweiss; (**y**) professional linoleum matrix based on jute fiber printed on kraft paper using water-based ink; fiberboard matrix configuration printed on kraft paper; (**z**) ordinary linoleum matrix configuration printed on cotton paper using oil-based ink, Komatex matrix configuration printed using a composite mixture of oil-based paint and water-based ink, fiberboard matrix configuration printed on cotton paper; Komatex matrix printed on cotton paper using water-based ink, ordinary linoleum matrix configuration printed on 100% cotton paper using oil-based paint.

As already mentioned, the experiments are numerous due to the use of the following types of bases: cardboard, fiberboard, plywood, Komatex, ordinary linoleum, professional linoleum formed on a jute fiber, vinyl and rubber. These are combined with the following types of paper: 100 cotton, offset thin cardboard, offset thin paper, thin kraft paper, kraft cardboard and glossy paper. In these experiments, the paper deformation and density, and the uniformity of the black tone were established. These materials were also combined with water-based ink, and ink obtained by mixing oil paint and Wienerweiss, where mixing employed different combinations of the quantities of the materials used.

4. Comparative analysis

The experiments conducted—with bases that are easily accessible and in which we are interested, with a variety of papers and two types of inks—make the study complete and easily accessible. All established parameters are described in detail—the composition of the bases, the methods of engraving and the result of the engraving, and the printing on paper with the two types of inks.

From the combination of all of these parameters comes the most important conclusion, which is the reason and purpose of the study—which base with which paper and at what pressure, depending on the image, do we obtain the best result for educational and possible professional purposes? The results are found in the tables with specified indicators. This type of experimental methodology is the basis for solving a number of design problems in practice or in the learning and teaching process [13]. The professional linoleum formed

on a jute fiber is suitable for any type of compositional images—both decorative and with fine nuances. Komatex and ordinary linoleum overlap in quality; the results of linoleum formed on a jute fiber in artistic compositions of a decorative type are stronger than those with hatched nuances. To the non-professional eye, the differences are insignificant, but the professional takes into account the decorativeness of both ordinary lino and Komatex and fiberboard. In a non-professional learning environment, the materials—linoleums of both types, Komatex and fiberboard—are suitable, as the teacher already has a basis on which to guide and comment on the student's project with the desired engraving tools used. The full set of conditions for how and why to choose some compositional means of expression over others in search of the most suitable option in the artistic creative search have been established.

Summary 1

When engraving on plywood and fiberboard (Figure 5), due to the higher modulus of elasticity in the matrix and the pronounced structural anisotropy, the contact pressure is concentrated in limited real contact areas, which leads to locally increased deformation of the paper and a pronounced tactile relief in the print, especially when using thin and kraft papers.

Summary 2

When using linoleum and Komatex, which are characterized by lower hardness and a more homogeneous structure, the applied pressure is distributed more evenly over the actual contact area, which reduces the depth of elastic deformation in the paper and favors the production of a clean, flat graphic image, especially in combination with industrial or very smooth papers and inks with lower viscosity.

Summary 3

In addition, multilayer cardboard, due to its fiber-composite structure and limited resistance to repeated loading, exhibits progressive deformation of the printing relief during repeated printing, which requires careful dosing of the pressure in the interval between the minimum pressure for full ink transfer and the threshold of plastic deformation of the paper, in order to avoid a loss of detail and uncontrolled expansion of the printing line. It is not suitable for letterpress printing in the context studied here, but it is good for other works such as collages of individual compositional elements.

4.3. Conclusions from the Experimental Methodology

Controlled variable pressure, fixed paper and ink parameters, sequential prints from different matrices.

In experimental conditions, the application of uniform contact pressure on matrices made of linoleum, engraving cardboard and fiberboard, polymeric materials with a higher modulus of elasticity and a pronounced fibrous structure such as fiberboard concentrate the pressure in smaller real contact areas, which leads to deeper local deformation of the paper and a clearly pronounced relief in the print, while with linoleum and engraving cardboard the pressure is distributed more evenly and results in a flatter, graphically clean image and evenly distributed ink, regardless of the area of the expressive means used in the image.

Comparative methodology

A side-by-side comparison of prints under identical printing conditions, with a focus on visual and tactile differences.

Comparative analysis of prints obtained from matrices of fiberboard, linoleum, and engraving polymers, under equal conditions of pressure and ink transfer, reveals a clear dependence between the hardness and homogeneity of the matrix material and the degree of paper deformation, with hard and anisotropic materials giving rise to more pronounced

relief and variability in the lines, while softer and homogeneous bases provide a stable contour and greater repeatability of the image.

Pedagogical methodology

Learning through practice, observation and analysis of results.

In a pedagogical context, experiments with linoleums, plastics and fiberboard allow learners to trace the direct relationship between applied pressure, paper deformation and visual results, and by comparing prints, an understanding is formed of how hard and fibrous materials require more precise control of pressure, while softer substrates allow for wider tolerance, which supports design through material thinking in graphics.

The three methodological approaches consider the same physical dependencies, but activate them in a different context—the experimental one seeks measurability, the comparative one seeks visual argumentation, and the pedagogical one seeks the formation of material sensitivity.

A comparative summary of the results with the materials and techniques used is shown in Table 4, and the pedagogical methodology employed is found in Table 5. Table 6 shows the relationships between the matrix material, pressure and deformation in letterpress printing.

Table 4. Influence of materials on the final result.

Material/Bases	Physical Characteristics	Influence on the Printed Result	How to Design the Project	How to Avoid Defects
Engraving cardboard	Rougher with a strong surface, high absorption.	Good resistance to pressure, ink stays on the surface.	Choose thicker lines and contrasting shapes for maximum visual impact, not suitable for standard engraving.	Clean prints, no blurring—enough ink but avoid spilling.
Linoleum formed on a jute fiber	Medium–hard material that determines the texture of the print.	Affects the roughness and relief of the print depending on the paper.	Allows fine nuance, takes into account the smallest detail, clean lines, solid tone.	Use the right paper, correct inking and measure pressure.
Linoleum for flooring	Hard and plastic material, affects the texture of the print.	Affects the roughness and relief of the print.	Design with clear contours and strong contrasts.	Use textures for artistic effect, avoiding too small details.
Komatex	Hard material.	Affects the roughness and relief of the print.	Design with a decorative bias.	Clean and independent spots, without accumulation of strokes and searching for light and shade.
Hardboard	Hard but ink-absorbent material.	With repeated inking—even and dense tone.	Does not allow for clean and categorical lines, suitable for images with a sought-after painterly effect.	Use the right paper—thin paper allows for a dense tone but also greater deformation, and hard cardboard avoids deformation but does not allow for even pressure.
Rubber	Very soft and smooth to the point of having difficulty holding ink of either type.	When inking gives good results, extremely demanding on the pressure from the press.	Gives a wide range of possibilities.	Use suitable paper.
Vinyl	Soft with an uneven surface structure.	Allows a clean image of the contours but dark surfaces lose density.	Not suitable for design, difficult to process, does not have characteristic qualities in the image.	Does not deserve attention in this study.

Table 5. Pedagogical methodology.

If the Material Is	Pressure Should Be	Expected Result
Hard and fibrous (plywood, fiberboard)	High	Embossed print
Soft and homogeneous (linoleum, rubber, Komatex)	Lower	Clean outline
Plastic and homogeneous (linoleum on a textile base)	Gradually increasing	Shading
Smooth paper	Minimal	Surface print

Table 6. Relationships between matrix, pressure and deformation in letterpress printing.

Base and Matrix Material	Structure and Hardness of the Base for Engraving	Contact Area	Pressure Behavior	Paper Deformation	Visual Result
Linoleum formed on a jute fiber	Homogeneous—easy to engrave.	Even	Even pressure.	Thin paper is deformed.	Clean and precise with precise contours in both shapes and shaded areas.
Rubber	Homogeneous—very soft but firm, easy to engrave.	Uneven	Ink smearing.	Due to the thickness of the base—strong.	Due to incompatibility with the tested inks—unsuccessful effect.
Fiberboard	Pressed fibrous structure, even with sharp tools the trace forms “whiskers” with each element and cut.	Variable, unstable	Increases with repetition.	Progressive.	Line expansion due to impurity of the cut elements.
Linoleum	Homogenous, hard, slippery when cutting, difficult to engrave.	Large, even	Well distributed.	Low-to-medium.	Clean images, suitable for decorative projects and compositions.
Cardboard for engraving	Layered, medium hardness, impossible to engrave, suitable for cutting parts and collages—easy to cut with a knife, but not to engrave.	Average; after repeated printing and inking it gives an even solid tone	Even but limited.	Medium—depends on the type.	Soft diffuse contour, slight relief.
Polymer (Komatex)	Controllable hardness, there is control when engraving.	Adjustable	Precise, dense tone and purity of lines, suitable for educational purposes and decorative compositions.	Medium—depending on the type.	Readable and precise.

How to use Table 6:

- **Experimental**
  - Paper and ink are fixed;
  - Only the material and pressure are varied;
  - Deformations and relief are compared.

- **Comparative**
  - Parallel prints;
  - Analysis of lines, tone and relief;
  - Derivation of visual dependencies.
- **Pedagogical**
  - Quick orientation for choosing a material;
  - Visualization of physical processes;
  - Development of sensitivity to pressure.

5. Conclusions

Conclusions by parameter groups:

1. Workability and sustainability

- The most durable materials for repeated use are plywood and Komatex as they benefit from high hardness and withstand long use.
- The easiest to cut are rubber and linoleum as they allow for quick and precise work with minimal effort.
- The best balance between durability and ease of work is linoleum formed on a jute fiber, which is the golden medium for manual and artistic graphics.
- The practical experience proposed here is not unknown, but systematization as a principle in methodology is a contribution as a way of thinking in the learning process.

2. Cutting and control

- With high precision and little resistance, linoleum and Komatex are ideal for hand tools.
- The lowest risk of the tool slipping is possessed by Komatex, rubber, and polymer linoleum—especially on smooth or wet surfaces.
- Plywood requires more control and strength, but produces relatively strong and long-lasting results.

3. Print quality

- The best ink adhesion comes from linoleum, plywood, and fiberboard, allowing for clear and saturated printing.
- The lowest adhesion (poor ink retention) is associated with cardboard, Komatex, and rubber; these may require primer or pretreatment.

4. Required printing pressure

- High pressure (needs a press): plywood and fiberboard—solid and hard.
- Low pressure (can work without a press): cardboard, Komatex and rubber—suitable for hand prints (with a tablespoon, roller, etc.).

The present study is aimed primarily at helping artists, providing a comprehensive overview of the materials and processes in printed graphics, facilitating the free use of expressive and compositional means. The current work is extremely relevant and the results in this form will fully meet the needs for practical work in creative subjects with an artistic focus represented in the program of the Engineering Design department at the Technical University of Sofia. The high and low print in the subject of Art Techniques already has its successful practices and given the great interest on the part of students, this study will strengthen creative searches outside of academic work. The results presented here are easily and accessibly applicable in any course of study at any educational level of secondary and higher education.

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