

Paper City Tales: Paper Models for Retelling Italo Calvino's *Invisible Cities*

Francesca Ronco, Giulia Bertola

Abstract

The work presented here involved the creation of paper models of Italo Calvino's *The Invisible Cities* [Calvino 2009], using different paper cutting and folding techniques to invent sets, forms, structures, and backdrops.

In the book's introduction, the author emphasizes how a layering of many elements characterizes cities. This characteristic led to the creation of models through different levels, which go to define a 'microcosm', a city in miniature perceptible through the senses, which becomes an object "to be thought, to be touched, to be looked at" [Croset 1987, p. 48].

From a technical point of view, the procedures adopted refer to research on paper folding, carried out by Joseph Albers [The Public Paperfolding History Project 2023] at the Bauhaus, those of Japanese master Masahiro Chatani [Chatani 1984] and British paper artist Paul Jackson [Jackson 2014].

Cuts, folds, linear divisions, and symmetrical repetitions make it possible to move from the two-dimensionality proper of paper to the three-dimensionality of the model. The research and related practice presented here converged in the Paper City Tales workshop at the Politecnico di Torino, held in the MODLab Arch model laboratory, developed by the authors, and coordinated by Prof. Marco Vitali. This experience saw third- and fourth-year students from Piedmont high schools try to construct Calvinian invisible cities.

Keywords: invisible cities, Italo Calvino, model, paper, imaginary cities

Introduction

The research presented here focuses on creating paper models to make Italo Calvino's invisible cities visible. The development of the theme, already dealt with from a semiological point of view by Fabrizio Gay [Gay 2015] and from a graphic/representation point of view by Mariagrazia Cianci and Daniele Calisi [Calisi 2016], has its formal and methodological roots in the thematic studies and workshops of Coca Frigerio and Alberto Cerchi [Cherchi 2010] and the board games of Bruno Munari. Architecture and the city are thought of as a large laboratory of experimentation in which Calvinian imagery overlaps with personal imagery. Just as in Munari's *Labirinto trasformabile in mille altri giochi*, these models represent "journeys into un-

known territories" and "ever-changing landscapes" [Frigerio, Cerchi 2010, p. 4].

Invisible Cities are characterized by structural, spatial, and temporal nonlinearity, so they represent an open field of experimentation [Panigrahi 2017; Cavallaro 2010].

The fifty-five cities of the book are divided into nine chapters, comprising 11 sets of five cities. Their streets, squares, and stone arches are like "words or phrases stretching out in a vast network, where the inside and the outside blur" [Vrbancić 2022, p.40].

The author takes the reader on a journey between the real and the unreal, where cities contain the image of what one wants and does not have. He describes cities through relationships and exchanges, providing

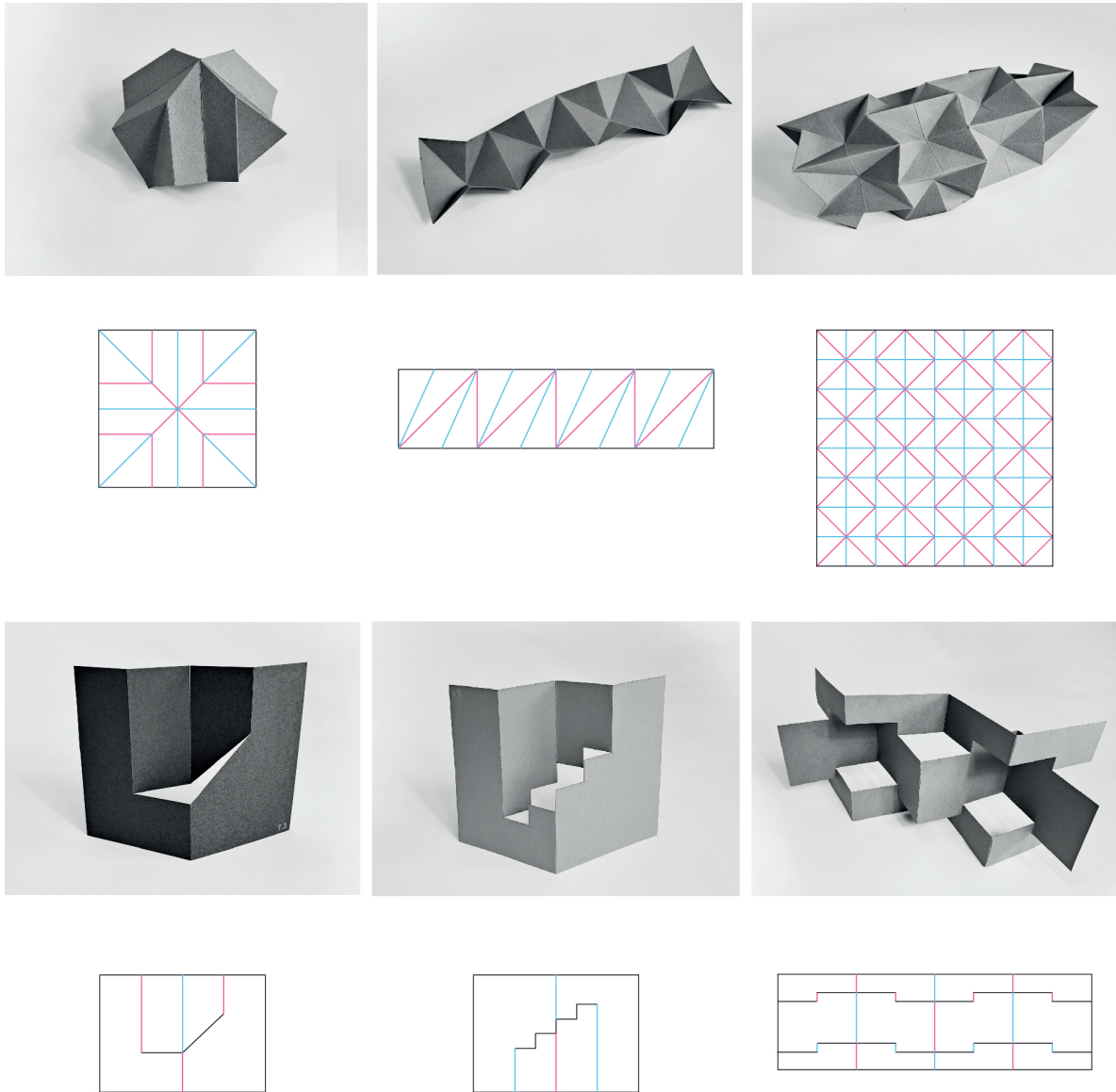


Fig.1. Folds and cuts: in cyan and magenta the downstream and upstream folds, in black the cuts (photographs, models and drawings by G. Bertola).

few and concise details, which leave endless possibilities for interpretation.

To this day, this text remains a landmark that has often inspired artistic and visual productions and is part of the bibliography of many university courses, including those in architecture.

Maps, cities, and narratives are always interconnected elements. Cities represent a palimpsest, a whole of intersections, points of view, intentions, and desires that form different planes and structures.

Calvinian cities are dynamic, challenging to schematize, and interconnected. Indeed, entanglement, lattice-work, constitutes one of their dominant topological structures (Smeraldina, Zora, Fillide, Ersilia, Armilla) [Barenghi 2009]. Each city contains the another one; maps and themes interconnect to constitute an imaginary geography. The catalog of forms is infinite: "until each form has found its city, new cities will continue to be born" [Calvino 2009, p. 140]. Each city in Calvino's text produces a narrative and logical restlessness that is impossible to read one-dimensionally.

In the attempt to transform invisible cities into visible cities, we also drew on Kevin Lynch's study, *The Image of the City* [1960], in which the author identifies the urban fabric of the main elements that define the objective public image and the multitude of individual, subjective images of its citizens.

From this basis, paper models were constructed to represent the stratifications described by Calvino and the elements we find in Lynch's work.

The following sections address the issues of the role of the model as a visualization tool, the use of paper models and techniques for moving from two-dimensional to three-dimensional space, and the *Paper City Tales* educational workshop into which these studies have converged.

The model as a tool for visualization and exploration

The model is understood here in its plastic sense, as defined by Tomás Maldonado [Maldonado 1987], a physical construct that can be modeled in a sculptural sense. This open-ended process is determined over time through continuous retouching and progressive rethinking.

Architects and designers have always used models differently as a design and configuration tool.



Fig. 2. *Paper City Tales* workshop: study and experimentation phase of papermaking techniques (photo by F. Ronco).



Fig. 3. Paper CityTales workshop: stage of project progress, selection of paper and first tests of composition (photo by F. Ronco).



Fig. 4. Paper CityTales workshop: final models (photo by G. Bertola).

Since the Renaissance, the client has been increasingly interested in 'seeing ahead', and it is this need to communicate the design that is at the origin of the profession of the architect. Indeed, the architect was born as a visualizer.

Architects use preliminary models to test and make visible ideas through simple three-dimensional forms. Because of their simplicity, these make it possible to quickly and easily study changes in the primary configuration of spaces, volumes, and masses. The activity of cutting, folding, and marking modeling materials makes the experience vivid in memory [Mindrup 2019].

French architect Le Corbusier used various materials, including paper and cardboard, to create fragile, flimsy, approximate three-dimensional models. Despite their imperfections, these models allowed the architect to study and evaluate the dimensions of spaces, the relationship of mass to other buildings, and the rhythm of openings as an idea before making final decisions.

The model is also used similarly in the design field, and this feature is particularly significant among children's products. The relationship between the child's body

and physicality is strong; the user is invited to wear-ride the object.

Another essential reference for the work presented concerning the creation of spaces are the thematic workshops by Coca Frigerio and Alberto Cerchi [Cerchi 2010], inspired by the analysis of form according to the observation and practical knowledge of materials and tools and the ateliers of the *Basic Space* project promoted by the Extra association [Extra 2016, 2018], focused on paths of architectural awareness and pedagogy of making.

Starting from these examples, architecture, the city, and contaminations with different artistic expressions can become an excellent laboratory to experiment, listen, and observe history and build solid foundations and utopias for the future.

Paper model: state of the art

As is well known, physical objects result from the combination of matter and form.



Fig. 5. Paper City Tales workshop: Detail image related to the city of Isaura (model by A. Bulai, photo by G. Bertola).

The material to be modeled is usually selected basing on its ability to represent a form or emulate the material characteristics of the proposed structure.

For an architect or designer who wishes to explore how extrinsic forces can be a source of inspiration for new formal and structural solutions, the modeling material is no longer a passive receiver of form but rather an essential actor in the process of morphogenesis [Höfler 2010].

In the age of digitization, contrary to the often-imagined scenario of loss of matter to the digital, current discussions of form in design and architecture begin precisely with the study of matter.

This paper focuses on creating three-dimensional formal experiences performed on paper and cardboard by exploring their technical and aesthetic qualities. Through cutting and folding operations, one can test the performance of paper subjected to stresses of tension and pressure, obtaining prismatic, fluid, and organic figures and different perceptions of solids and voids. Numerous examples of architects, designers, and artists have been confronted with the three-dimensional paper model.

The didactic experiments performed in the 1920s at the *Bauhaus* by Josef Albers and aimed at studying the stability, load-bearing capacity, and strength of paper [Albers 1928] and those of artist, mathematician, and designer Ron Resch, inventor of geometric models for three-dimensional tessellations and undulations [Callens 2017] are particularly interesting. There are also the works of German architects Michael Hensel and Achim Menges aimed at promoting a paradigm shift toward the re-materialization of form through the development of parametric models [Hensel, Menges 2008] and those of EPFL architects Sion Hani Buri and Yves Weinand and of engineer Tomohiro Tachi based on the production of complex structures using origami technique [Buri 2010; Mindrup 2019; Tomohiro 2010]. Further references on using paper as a plastic tool of prefiguration can be found, as anticipated, in some projects dedicated to childhood and design. Paper, whether fine-grained or thick, textured or colored, white or written or even drawn, is often the medium between the user and the artifact. Examples are Bruno Munari's *Prelibri*, twelve small books of various materials bound differently, and the animated, or pop-up, books by Matthew Reinhart and Robert Sabuda.



Fig. 6. Detail image related to the city of Eudossia (model by I. Ferrero, photo by G. Bertola).

Also by Munari [MunArt] are the *sculture da viaggio* (travel sculptures), while in the *Me Too Collection* by Magis (2012) [1], we find cardboard animal figures by Martí Guixé.

In other cases, paper and cardboard become the vehicle and support of learning methods of design processes that, starting from drawing, develop into a composition of figurative narratives, into collages, into making maps, paper models, or small shelters.

Liya Mairson, for example, with her project *My Space*, composes a series of pop-up mini-scenographies that define real spaces. Marie Compagnon, with *Habitadule*, invites, with sixteen large cardboard panels, the creation of large three-dimensional structures that are always different, giving rise to various architectures and sceneries.

Therefore, the paper asserts itself as a valuable tool for experimenting, learning, manipulating, and composing. It allows one to project from the two-dimensional plane to the third dimension and develop primary geometries or complex shapes through simple gestures.

Methodology: paper cutting and folding techniques

The proposed activity was based on two papermaking techniques: cutting and folding to make three-dimensional pop-ups.

The choice of paper varies depending on the size of the final model and must have a good balance between strength and flexibility. For example, for models of size 20 x 30 cm, the ideal paperweight is 160 and 200 g/m² and can be of different types (smooth, rough, glossy, matte, recycled paper); alternatively, thin plastic (polypropylene type) can be used. Such materials can be worked with simple tools such as 2H-type pencils, plastic and metal rulers and squares for cutting operations, bone folders, cutters, scalpels, protractors, compasses and curvilinear, adhesive tape, glues, and self-healing cutting mats.

The technique used is that of pop-up, generally regarded as a three-dimensional object that takes shape when a folded sheet of paper is opened 180°; the objects inside are usually cut and glued together.

For the case study, the 90° opening pop-up technique was adopted instead, a typology popularized in the 1980s by architect Masahiro Chatani [Chatani 1984]

and called *Origamic Architecture*. This type of metamorphic operation allows, during the transition from 2D to 3D form, no loss and no addition of material: the single rectangular sheet of cardboard is initially folded in two and then opened at 90°. Attractive visual effects arise from the cutting and folding operations: each negative space is matched by a positive one, which increases visual complexity [Jackson 2014]. Pop-ups can have greater or lesser degrees of complexity depending on the number and position of cuts and folds, which can be symmetrical or asymmetrical and performed on papers of different shapes. The paper can be divided into various lengths and angles, with the help of a ruler and pencil, or even manually by performing progressive divisions (into halves, quarters, eighths, etc...). During folding operations, it is necessary to consider the downstream and upstream folds and the four basic types of two-dimensional symmetry (translation, reflection, rotation, and glide reflection) [Jackson 2011] that can be used, as well as their modifiability through the different pleating operations (fig.1).

The case study: the *Paper City Tales* workshop

Paper City Tales is the title of the workshop included within the program of *Percorsi per le Competenze Trasversali e l'Orientamento* (PCTO) for high schools, conceived and coordinated by the authors of this contribution, in collaboration with Prof. Marco Vitali, scientific referee, and with the support of the Department of Architecture and Design (DAD) and of the ModLab Arch of the Politecnico di Torino.

From a didactic point of view, the main objectives and skills to be acquired concerned the following aspects: to know how to combine humanistic, scientific, and technical-practical knowledge; to stimulate design thinking, that is, to facilitate the creative process through a sequence of phases (brainstorming, design, and prototyping); to promote a learning-by-doing approach that allows learning by using direct experience on the subject; to bring students closer to the culture of maker, digital and manual fabrication; to bring students closer to the techniques and the design language of the architect and designer; to learn how to transpose the contents of the written language through



Fig.7. Detail image related to the city of Dorothea (model by V.Togni, photo by G. Bertola).

different means of expression such as geometry, representation and three-dimensional manual modeling. Eleven students from different Piedmont institutions of both scientific and humanities backgrounds participated in the project and were involved in the activity for eighteen hours. The first edition of the course was held in June 2023 at ModLab Arch.

On that occasion, *The Invisible Cities*, described in Italo Calvino's book, were transposed onto paper using the previously outlined processing techniques.

The proposed workflow included choosing paper, instrumentation, and presentation of the leading folding and cutting techniques and composition operations.

Students were equipped with a series of cutting and folding patterns that led to drafts on commonly used paper (fig.2) to make some compositions and evocative structures containing fragments of real cities. During the workshop activity, a great deal of freedom was allowed to go beyond the proposed techniques to experiment freely by fully exploiting the three-dimensional potential of paper in the autonomous discovery of new forms and new imagery (figs. 3-7). As Calisi stated: "representing Calvino triggers a continuous circle in which those who read imagine, those who imagine draw images, and those who look have their visions in turn" [Cianci, Calisi 2016, p. 1388].

Conclusions

The experience presented here is one of the possible applications in the field of representation for generating imagery and settings from written texts. The result was three-dimensional collages that created evocative scenarios from a few simple models. The origami architecture models provided initially facilitat-

ed the creative process, avoiding the embarrassment of the blank sheet of paper. Interestingly, starting from the same initial elements, completely different architectures and landscapes can be generated by making simple scale changes, rotations, and compositional variations.

The diversity of solutions and visions that can arise provides a counterpoint to the complexity of *The Invisible Cities* narrative. Bauci, Despina, Dorothea, Eudoxia, Isaura, Maurilia, Octavia, Smeraldina, Sofronia, Zenobia, and Zora are the cities read and interpreted, creating new pieces of the story and a new image resulting from the encounter between words and imagination.

In the field of image creation from written texts, Artificial Intelligence (AI) hints at a possible development of this work. Indeed, the rapid rise of generative AI has opened new horizons in architectural design, causing a paradigm shift. The current resurgence in interest in AI, as Mario Carpo argues, is justified due to the immense memory and processing power of today's computers [Carpo 2023].

AI makes it possible to move away from the conventional Cartesian framework, leading the viewer into the uncharted terrain of latent [Abdal, Qin, Wonka 2019] and multidimensional space told through generative models [Huang, Wang, Jiang 2023].

In this way, it becomes possible to bring previously unknown images to life from structured text segmentation and keyword identification.

This application could be helpful in the workshop context presented here, allowing for easy creation of images that could be used as a cue for the work, combining manual and virtual practice.

Calvinian cities, due to the descriptive richness of spaces, landscapes, architecture, and dimensional scales, could be well adapted to such a workflow.

Note

[1] Guixé, M. (2012). *Me Too Collection, cardboard animal figures*, Motta di Livenza: Magis 2012.

Acknowledgements and Credits

The paper is the joint work of the two authors in particular Francesca Ronco wrote the paragraphs: *Introduction, The model as a tool for visualization and exploration, The case study: the Paper City Tales workshop*; Giulia Bertola wrote the paragraphs: *Paper model:*

state of the art, Methodology: Paper cutting and folding techniques, Conclusions.

We thank the students participating in the *Paper City Tales* project, June 2023 edition.

Authors

Francesca Ronco, Dipartimento di Architettura e Design, Politecnico di Torino, francesca.ronco@polito.it
Giulia Bertola, Dipartimento di Architettura e Design, Politecnico di Torino, giulia.bertola@polito.it

Reference List

- Abdal, R., Qin, Y., Wonka, P. (2019). Image2StyleGAN: How to Embed Images into the Stylegan Latent Space? In *2019 IEEE/CVF International Conference on Computer Vision (ICCV)*, Seoul, 27 October 27 - November 2, 2019, pp. 4431-4440. Piscataway: IEEE Computer Society Conference Publishing Services (CPS).
- Albers, J. (1928): *Werklicher Formunterricht*. In *Bauhaus*, No. 2/3, pp. 3-7.
- Barengi, M. (2009). *Italo Calvino, le linee e i margini*. Bologna: Società editrice il Mulino.
- Buri, H. U. (2010). *Origami-Folded Plate Structures*. PhD thesis in Structures. Supervisor/tutor Prof. Y. Weinand. École Polytechnique Fédérale de Lausanne.
- Callens, S. J. P., Zadpoor, A. A. (2017). From flat sheets to curved geometries: Origami and kirigami approaches. In *Materials Today*, No. 21(3), pp. 241-264.
- Calvino, I. (2009). *Le città invisibili*. Milano: Mondadori.
- Carmo, M. (2023). A short but believable history of the digital turn in architecture. <<https://www.e-flux.com/architecture/chronograms/528659/a-short-but-believable-history-of-the-digital-turn-in-architecture/>> (accessed 28 February 2024).
- Cavallaro, D. (2010). *The Mind of Italo Calvino: A Critical Exploration of His Thought and Writings*. Jefferson: McFarland & Company.
- Chatani, M. (1984). *Ondori pop-up origamic architecture*. Tokyo: Japan Pubns.
- Cianci, M., Calisi, D. (2016). Narrare l'irreale. Le città invisibili svelate. In S. Bertocci, M. Bini (Eds.), *Le ragioni del disegno: pensiero, forma e modello nella gestione della complessità*, pp. 1383-1390. Rome: Gangemi ed.
- Croset, P. A. (1987). Microcosmi dell'architetto. In *Rassegna*, No. 32, pp. 47-56.
- Extra (2016). *Basic Space. Espaces graphiques*. Italy: Extra éditeur d'espaces.
- Extra (2018). *Basic Space. Expérimenter l'espace à l'école*. Italy: Extra éditeur d'espaces.
- Frigerio, C., Cerchi, A. (2010). *La città in scena*. Bazzano: Artébambini.
- Gay, F. (2015). "... un disegno così sottile da sfuggire al morso delle termiti": categorie eidetiche e valori in gioco sulla scacchiera de Le Città invisibili. In A. Marotta, G. Novello (Eds.), *37th International Conference of Teachers of the disciplines of the Representation. UID 2015 – Disegno & Città. Cultura, Arte, Scienza, Informazione / Drawing & City. Culture, Art, Science, Information*. Turin, 17-19 September 2015, pp. 169-176. Roma: Gangemi.
- Hensel, M., Menges, A. (2008). (Eds.). *Form Follows Performance: Zur Wechselwirkung von Material, Struktur, Umwelt*. ArchPlus No. 188. Aachen: ArchPlus Verlag.
- Höfler, C. (2010). "Seeing by doing". Josef Albers und die Materialisierung des Digitalen. In *Kunst und Design*, No. 1, pp. 1-12.
- Huang, S.-Y., Wang, Y., Jiang, Q. D. (2023) (In)Visible Cities: Exploring generative artificial intelligence's creativity through the analysis of a conscious journey in latent space. In F. García Amen, Á. Armagno Gentile, A. L. Goñi Fitipaldo (Eds.), *Conference: XXVII SIGraDi Conference 2023: Accelerated Landscapes*. Punta de l'Este, Maldonado, Uruguay, November 29 - December 1, 2023, pp. 717-728. Uruguay: Facultad de Arquitectura Diseño y Urbanismo (UdelaR).
- Jackson, P. (2011). *Folding techniques for designers from sheet to form*. London: Laurence King Publishing.
- Jackson, P. (2014). *Cut and Fold Techniques for Pop-Up Designs*. London: Laurence King Publishing.
- Lynch, K. (1960). *The Image of the City*. Cambridge: The MIT Press.
- Maldonado, T. (1987). Questioni di similarità. In *Rassegna*, No. 32, pp. 57-62.
- Mindrup, M. (2019). *The Architectural Model. Histories of the Miniature and the Prototype, the Exemplar and the Muse*. Cambridge: The MIT Press.
- MunArt. <<https://www.munart.org/index.php?p=19>> (accessed 28 February 2024).
- Panigrahi, S. (2017). Postmodern Temporality in Italo Calvino's Invisible Cities. In *Italica*, No. 94 (1), pp. 82-100.
- The Public Paperfolding History Project. <<https://www.origamiheaven.com/historyjosephalbers.htm>> (accessed 28 February 2024).
- Tomohiro, T. (2010). Freeform Variations of Origami. In *Journal of Geometry and Graphics*, No. 2(14), pp. 203-215.
- Vrbčančić, M. (2022). How to Map the Invisible. In B. Linder (Ed.), *Invisible Cities and the Urban Imagination*, pp. 39-47. Cham: Springer.