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In 1920s Moscow, VKhUTEMAS's spatial pedagogy challenged conventional teaching methods in a way that is highly relevant to contemporary architectural education.

Teaching Space: Experimentation at VKhUTEMAS

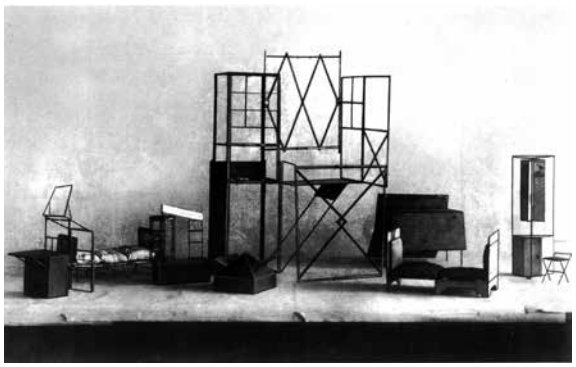
Matthew Armitt and Marco Iuliano

This paper aims to analyse the sequential structure and delivery of the Space course at VKhUTEMAS between 1923 and 1927, exploring how its pedagogical lessons might be brought into dialogue with contemporary architectural education.

VKhUTEMAS (*Vysshie gosudarstvennye khudozhestvenno tekhnicheskye masterskie*, or Higher State Artistic and Technical Studios) was an expression of Soviet society after the 1917 October Revolution. The avant-garde pedagogical experiment emerged in Moscow as the result of radical reform implemented by the Soviet Ministry of Education to train the proletarian class to develop a new artistic culture capable of addressing the growing needs of industrial production. Vladimir Lenin, head of State after the Revolution, knew that to fulfil the communist ideals he and his party had subscribed to, the country had to be transformed into a workers' State where education and endeavour would be a paramount aim.[1]

The very geography of the country proved something of a challenge to achieving universal education. However, changes were made to the old academic systems in the year following the transference of power that drastically altered education in the nascent Socialist nation:[2] *Narkompros*, the agency charged with the administration of public education, implemented a new artistic programme devised by Anatoly Lunacharsky.[3] Lunacharsky reorganised the creative training, paying particular attention to the links between art and industry. In 1918, Free Art Studios (SGKhM) were established in several cities, including the Stroganov School of Industrial and Applied Art (SKhPU) in Moscow and the School of Painting, Sculpture, and Architecture (UZhVZ) in Leningrad. Led by prominent artists from leftist movements, these workshops created a free-spirited educational system based on the most advanced artistic tendencies of the day. The first Free Art Studios went on to be restructured, later becoming a unified school in November 1920 – VKhUTEMAS – through a state decree signed by Lenin.[4]

1 Alexander Rodchenko, photograph from a balcony of the VKhUTEMAS, c. 1927.



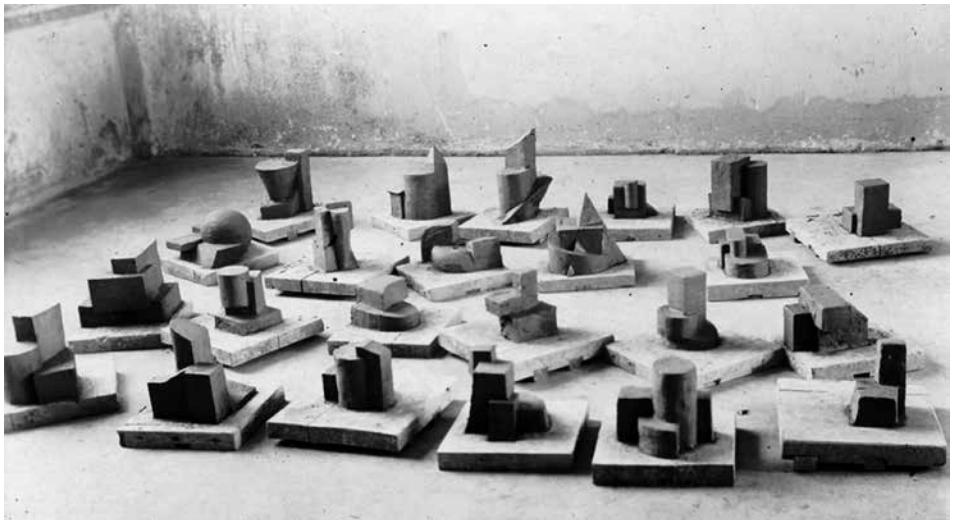
2 Students' work from Rodchenko's Metalworking studio at VKhUTEMAS, Moscow, 1923.

VKhUTEMAS offered one of the first alternatives to the classical academic atelier and apprenticeship models of the French École des Beaux-Arts, consisting of eight art and production departments – Architecture, Painting, Sculpture, Graphics, Textiles, Ceramics, Wood, and Metalworking – integrating artistic culture with industrial production. The teaching methodology was a consequence of the educational mandate for the large numbers of Soviet students who could no longer be trained in the traditional one-to-one system, and the curriculum was delivered over five years: two for the Basic division (*Osnovnoe otdelenie*), two-and-a-half of specialisation, and six months for a final diploma project *[1, 2]*.[5]

The Basic division and Space

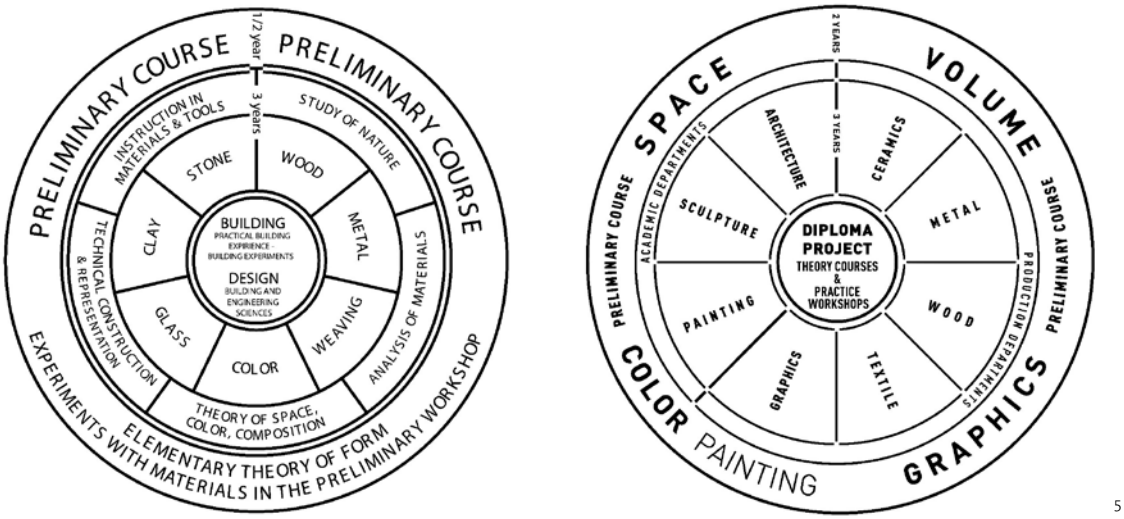
Following the establishment of VKhUTEMAS in 1920, Nikolai Ladovsky (1881–1941), Nikolai Dokuchaev (1891–1944), and Vladimir Krinsky (1890–1971) – VKhUTEMAS teachers collectively known as the Rationalists[6] – began their search for a new means of architectural expression by experimenting with the latest formal artistic achievements.[7] They did so in a rich and dynamic cultural environment that gave them opportunity to develop their pedagogy in alignment with the State's own priorities. The Rationalists fundamentally proceeded from the assumption that architecture possessed expressive qualities, which, if consciously harnessed by the designer, could facilitate the observer's spatial comprehension and orientation within the built environment.[8] These reflections led Ladovsky to declare that 'Architecture is the art that operates with space'; that 'Space is present in every artistic discipline, but only architecture offers the possibility for a correct reading of space'; and ultimately, that 'Space is the material of architecture, and not stone.'[9]

Although 'space' was well established as a term in the vocabulary of art and architecture by 1920s, his claim that architecture was an art not of materials but of space was still radical for the time.[10] The philosophy outlined by Ladovsky was elaborated in



3 **Display of student exercises for the Volume course at VKhUTEMAS, 1920s.**

4 **Student exhibition for the Colour course at VKhUTEMAS, c. 1926.**



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5 Diagrams of the curricula: Bauhaus (1922, left) and VKhUTEMAS (1923, right). Drawings by Anna Bokov.

practical terms by Krinsky when, as early as in 1921, he spoke about 'the line, the plane, the geometrical shape (sphere, cylinder, cone)' as 'eternal elements', concluding they were 'not forms but concepts, by whose help we arrive at a concrete given form. It is not an idea given a priori, […] it is our way of thinking in real space.'[11]

The Rationalists tested their new concepts through selected students at OBMAS (*Ob'edinennye levye masterskie*, United Leftist Studios, 1920–23), a teaching studio active at VKhUTEMAS where it developed the Psychoanalytical method (*Psikhoanaliticheskiĭ metod*).[12] Demanding continual adjustments and rigorous annual revisions, OBMAS represented the ultimate arena to refine the experiments and the pedagogy towards a new academic course: Space.[13] Taught to VKhUTEMAS's students, Space was formally established in 1923 as the core of four specialties courses in which the new Basic division was organised (the course leader follows in parenthesis): Graphics [*Graficheskii*, Alexander Rodchenko (1891–1956)], Colour [*Tsvetovoi*, Alexander Vesnin (1883–1959) and Lyubov Popova (1889–1924), further on Gustav Klutsis (1895–1938)], Volume [*Obemnyi*, Anton Lavinsky (1893–1968), and Boris Korolev (1884–1963)], and Space [*Prostranstvennyi*, Vladimir Krinsky (1890–1971)] *[3–5]*.[14] Despite having conceived its structure, Ladovsky never taught Space in its curriculum. However, in the autumn of 1923, he recommended six of his former students to the new director of the school, Vladimir Favorsky, as teachers at the Basic division: Viktor Balikhin, Sergey Glagolev, Mikhail Korzhev, Ivan Latmsov, Viktor Petrov, Yury Spassky, and Mikhail Turkus.[15]

The four courses – Graphics, Colour, Volume, and Space – defined the foundation of VKhUTEMAS's teaching methodology, the unifying element of the school at Moscow. It was made compulsory for all students to move through the four – starting from Graphics and concluding on Space – to reach the completion of their basic learning. Each course was taught using a variety of mediums: Graphics transformed the traditional drawing training from still life to geometry, devising abstract compositions with primary elements; Colour, after the acquisition of scientific knowledge, concentrated on generating compositions either through colour assonances or contrasts; Volume, reminiscent of training in sculpture, analysed the presence of mass in space and its dynamic articulation rendered through clay models. Space became the central part of the new pedagogy, the key element in architectural-artistic education, where it was possible to apply the abstract knowledge acquired in the first three courses *[3, 4]*.[16] Students were encouraged to think not about orders and proportions but about the human being who perceived them, reflecting the belief that only emotional and visual perception could form the basis of architectural compositions.[17] As Natalia Adaskina noted, Ladovsky's method of studying the general laws of spatial form was adopted by different specialists to teach art subjects at the Basic division.[18]

While the majority of VKhUTEMAS's students were Russian, reflecting the school's role in the Soviet teaching of architecture, art, and design, they held a variety of other backgrounds, including Ukrainian, Jewish, Armenian, Tatar, Belarusian, Latvian, as well as representatives of other Soviet nationalities. Students, and sometimes artists from all over Europe and beyond, were drawn to the school because of its reputation for revolutionary teaching and the significant contribution to the avant garde.

Analogies have been drawn between VKhUTEMAS's 1923 Basic division and Bauhaus' foundation course (*Vorlehre* or *Vorkurs*) taught since 1922 by Johannes Itten. There is no doubt that VKhUTEMAS's interdisciplinary curriculum had similarities to that of the Bauhaus. However, in other respects, the two courses were fundamentally different, with students only spending six months as introductory period at Weimar, compared to the two preliminary years in Moscow *[5]*. Furthermore, Walter Gropius's experiment developed within an established administrative and economic infrastructure, whereas VKhUTEMAS identified with

the new revolutionary state and was directed by artists who were themselves stakeholders of policies for the government.[19] Starting from a more conservative stance that was rooted in the prevailing German artistic culture and occupying a marginal avant-garde position, the Bauhaus became a fashionable design and architecture school in the second half of the 1920s, while VKhUTEMAS started out as a revolutionary institution during the 1920s and its artists and activities were relegated to the margins by the end of the same decade, even if its ideas continued to develop outside the school and took physical shape in the built environment. Both schools aimed for a unity of art and technology, a common philosophical feature being their willingness to engage with society, but VKhUTEMAS's challenge was to create this unity for the working class, which resulted in a fundamental difference. The number of students attending the respective schools differed greatly: for example, during the 1924–5 academic year, VKhUTEMAS attracted 1,445 pupils, while the Bauhaus enrolled just 127.[20] Perhaps the most important aspect the two institutions had in common can be found in their roots: as highlighted by Luka Skansi, both VKhUTEMAS and Bauhaus owed their origin to German art history and philosophy, the so-called Munich Formalist School, which shaped many Russian and Soviet artists and art theorists before the First World War.[21]

Teaching Space (1923–7)

The central question that emerges and has yet to be adequately addressed in existing scholarship is how Space was taught at VKhUTEMAS.

Selim O. Khan-Magomedov and Anna Bokov are the primary references for the study of VKhUTEMAS's pedagogy. In his books *VKhUTEMAS* (1990) and *Ratsionalizm* (2007), Khan-Magomedov makes significant attempts to reconstruct the sequence of the Space course based on firsthand documentation. His interpretive framework, though largely speculative, identifies several pedagogical descriptions, but these are not presented in a clearly defined order, and the archival sources he relies upon are not rigorously referenced.[22] This makes it difficult to evaluate or verify his scholarly work. Since then, Bokov has adopted Khan-Magomedov's approach, particularly in her *Avant-garde as Method: VKhUTEMAS and the Pedagogy of Space* (2020), where she addresses the teaching of Space as a system of exercises, offering a detailed and updated historical account of Khan-Magomedov's research.[23]

Bokov's monograph represents a significant advancement in academic discourse, particularly through her translation of primary Russian sources into English and the inclusion of a rich visual apparatus with annotated assignment drawings, several of which were published for the first time. While both authors disclose a wealth of material, a comprehensive analysis on how Space was taught remains elusive, maybe due to the inherently fragmented character of its teaching. The issue is further compounded by the loss of the original VKhUTEMAS models, which were central to its pedagogy and now survive only in photographs; these, together with manuscripts and published texts, form the core sources available to revisit the school's educational practices. The methodology of this research is grounded in a close analysis of these sources: it re-examines Khan-Magomedov's and Bokov's findings, cross-referencing them with manuscripts, printed documents, and archival photographs, in order to move beyond the traditional speculative framework.

The research encompassed visits to several institutions: the Moscow School of Architecture (MARKhI), the Shchusev State Museum of Architecture (Moscow), the Russian State Archive of Literature and Art (RGALI, Moscow), Richard

6 Vladimir Krinsky with Mikhail Korzhev (left, in checked shirt) and Mikhail Turkus (wearing tie) discussing assignments with students, 1923–7.

Saltoun Gallery (London), the University of Cambridge Slavonic Collections, and the Canadian Centre for Architecture (CCA, Montreal). During the research, several descriptions discovered on the versos of archival photographs enabled the identification of corresponding documents and their role within the broader educational structure: some elements identified by Khan-Magomedov were omitted from this 'reconstruction' due to their factual inaccuracy, redundancy, or lack of consistency. Instead, this study proposes a refined pedagogy consisting of seven essential stages in the teaching of Space at VKhUTEMAS:

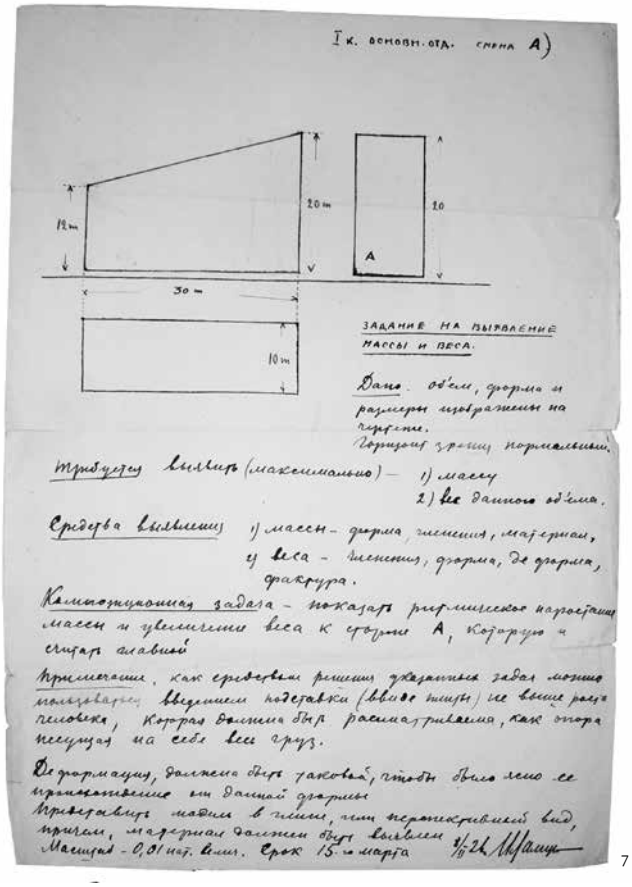
stage one – discussion and issuing of the assignment
stage two – presentation of visual materials
stage three – construction through modelling
stage four – collective discussion
stage five – development of critical skills
stage six – examination by commission
stage seven – exhibition of students' work.

The first stage of Space involved discussion of the assignment with the course leader, Vladimir Krinsky. Figure 6 shows how the dialogue took place between a small group of teachers and pupils, and the inclusion of sheets of paper and drawing apparatus provides evidence of ideas and assignments under consideration. The dynamic of this early stage reveals an emphasis on developing a moment of exchange, prior to the commencement of work on the task, and on providing students with contextual information *[6]*.

Issuing the assignment served as an entry point into the individual component of Space; students subsequently received a step-by-step instruction without a copy of the assignment itself, which may explain the scarcity of manuscripts of this kind. Bokov identifies twenty-six different assignments devised between 1924 and 1926 and divides them in six groups, following the categorisation suggested by Khan-Magomedov: 1. Surface; 2. Frontal Space; 3. Volumetric Form; 4. Spatial Form; 5. Mass and Weight; 6. Deep Space.[24]

A recurring feature of every assignment, regardless of its specific character or category, was the requirement to transform two-dimensional geometric elements into a perspectival drawing or a model. This also involved demonstrating the means of articulation and translating compositional thoughts into an artefact, always considering the view at eye level. The task allowed a degree of interpretation by the student, who was to construct a convincing solution through an incremental process of familiarisation with spatial imagination.

Figure 7 is an example of one such assignment; it concerns Mass and Weight and is dated 8 February 1926. Devised by Ivan Lamtsov, the assignment provides instructions to intersect volumes in plan, section, and elevation. According to Lamtsov, the main point of the exercise was to 'show the rhythmic increase in mass and the increase in weight in respect to site A which should be considered the main site', and 'the model should be constructed either out of clay or in perspective.'[25] *[7]* This is the full translation of the assignment:



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7 Ivan Lamtsov, assignment on Mass and Weight, 1926.

Assignment on the articulation of Mass and Weight

Given: a volume, shape, and dimensions are shown in the drawing. The view horizon of the building is normal

Required: to articulate (maximally)
1) Mass;
2) The Weight of this volume.

Means of articulation
1) Mass – form, division, materiality;
2) Weight – division, form, de-form, texture.

Compositional task: to show the rhythmic growth in mass and the increase in weight towards the side A, which is to be considered the main one.

Note: as a means of solving these tasks, it is allowed to use a stand (in the form of a plate) not taller than the height of a person, which can be considered as a support that carries the entire load.

The deformation should be such that its origin from this form is clear.

Present a model in clay, or a perspective view; moreover, the material should be articulated. Scale is 0.01 of full size.

Deadline – March 15. 8 / II [19]26

I. Lamtsov

монтаж готовых частей. Монтаж может производиться БЕЗ ЛЕСОВ: до наводки верхних форм стойки держатся на тросах. Поэтому стройка может итти не прерывая движения площади. Затем по отношению к существующим постройкам то качество, что их почти не нужно сносить. Огромные преимущества в наличии света и воздуха по отношению к американскому башенному типу небоскреба.

ФОРМА СТЕН ТИПА

1. При пластическом оформлении этого сооружения, я учитывал конструкцию лишь как один из первичных элементов в достижении необходимого полезного действия (механического эффекта). Я бы с той-же логической последовательностью, так же удовлетворяя всем утилитарным требованиям мог избрать другую конструкцию*), если-б хотел достигнуть другого эстетического эффекта.

2. Я считаю, что в своей основе сила эстетического эффекта определяется не качеством и не количеством,—это есть состояние, температура.

3. Я исходил из равновесия двух пар контрастов:
   а) Город состоит из атрофирующихся старых частей и растущих живых, новых. Этот контраст мы хотим углубить.
   б) Дать самому сооружению пространственное равновесие, как результат контрастных вертикальных и горизонтальных напряжений.

4. Дать новый масштаб городу, в котором человек сегодня больше не мерит собственным локтем, а сотнями метров.

5. Элементарно организовать сооружение из ребер, плоскостей и об'емов, сквозных, прозрачных и плотных, вместе составляющих однозначную пространственную систему.

6. Со всех основных 6-ти точек зрения данное сооружение однозначно характеризовано:

Перспектива вдоль бульвара.

Схема формы при виде:

По направлению:

1. Сверху	2. Снизу	3. К Кремлю	4. От Кремля	5. Вдоль бульвара	6. В обратную сторону:

Такая характеристика делает ориентировку по этим сооружениям в городе совершенно ясной. При установке всей серии, введение цвета для отметки каждого небоскреба в отдельности послужит к усилению его ориентировочных качеств.

*) В выработке и расчете конструкции мне помогал ЭМИЛЬ РООТ (Цюрих), которому и рад и здесь выразить свою признательность.

В следующей серии (W B 2) будет показана совершенно другая конструкция.

Этот проект (Wolkenbügel) был впервые демонстрирован на выставке Ноябрьской группы в Берлине, затем на международной выставке современной архитектуры в Мангейме.

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Основы построения теории Архитектуры

(Под знаком рационалистической эстетики)

Н. ЛАДОВСКИЙ

Архитектурная рациональность видится на экономическом принципе так же, как и техническая рациональность. Разница заключается в том, что техническая рациональность есть экономия труда и материала при создании целесообразного сооружения, а архитектурная рациональность есть экономия психической энергии при восприятии пространственных и функциональных свойств сооружения. Синтез этих двух рациональностей в одном сооружении и есть рацио-архитектура.

Часть I. О ФОРМЕ.

1. При восприятии материальной формы как таковой мы одновременно можем усмотреть в ней выразительность качеств:

1) геометрических — отношения сторон, ребер, углов, характер поверхностей и т. д.

2) физических—весомость, плотность, массу, и т. д.

3) физико-механических—устойчивость, подвижность,

4) логических—выразительности поверхности как таковой и ограничивающей об'ем . . . . . .

В зависимости от выразительности величины и количества мы можем говорить о:

а) мощи и слабости,

б) величии и мизерности,

в) конечности и бесконечности. . .

2. Архитектура оперирует этими „качествами" как определенными величинами. Архитектор конструирует форму внося элементы, которые не являются техническими или утилитарными в обычном смысле слова и которые можно рассматривать как „архитектурные мотивы". В архитектурном отношении эти „мотивы" должны быть рациональны и служить высшей технической потребности человека **ориентироваться в пространстве** . . . . . .

Для иллюстрации одного из видов работы над геометрической выразительностью формы рассмотрим

Черт. № 1.

Пример 1.

3. Две проекции параллелопипеда **дают** о нем точное геометрическое **представление – образ** (черт. № 1).

Реальная перспектива его, предоставленная в ряде статических моментов 1, 2, . . черт. № 2, дает приближенный образ, стремящийся к геометрическому, выраженному в двух проекциях, как к своему пределу.

4. Работа архитектора над геометрической выразительностью формы, которую мы всегда воспринимаем в перспективе, заключается в приближении образа получаемого от восприятия реальной перспективы к образу, данному в проекциях.

Степенность приближения зависит от количества и качества, входящих в конструируемую архитектором систему определения—элементов-признаков. Материалом этой системы элементов-признаков, обычно служит в сооружении видимая техническая конструкция. Там, где она может быть использована полностью создается синтез техники и архитектуры, где этого

8

8 Nikolai Ladovsky's article on *Izvestiia ASNOVA*, 1926.

Ladovsky's own comments on an earlier task assigned at OBMAS, published in a 1926 issue of *Izvestiia ASNOVA* – towards the end of VKhUTEMAS's existence – offer valuable insight into the logic and intent behind the exercises, which encapsulate the very essence of the school's pedagogy. On this occasion, it is not the exercise itself or its result that is of interest, but rather the clarifications provided by his instructions, which might have been similar to the dialogue that took place between the teacher and his students. Ladovsky specified that the project should situate 'the viewer at 1.60 metres and [with] a dynamic perspective', the main task being 'to articulate the geometric properties of the parallelepiped for a spectator.'[26] In doing so, he specifies what might be seen as a central question running through the Space course and its assignments – a question suggesting the continuity between geometric expression and spatial exploration:

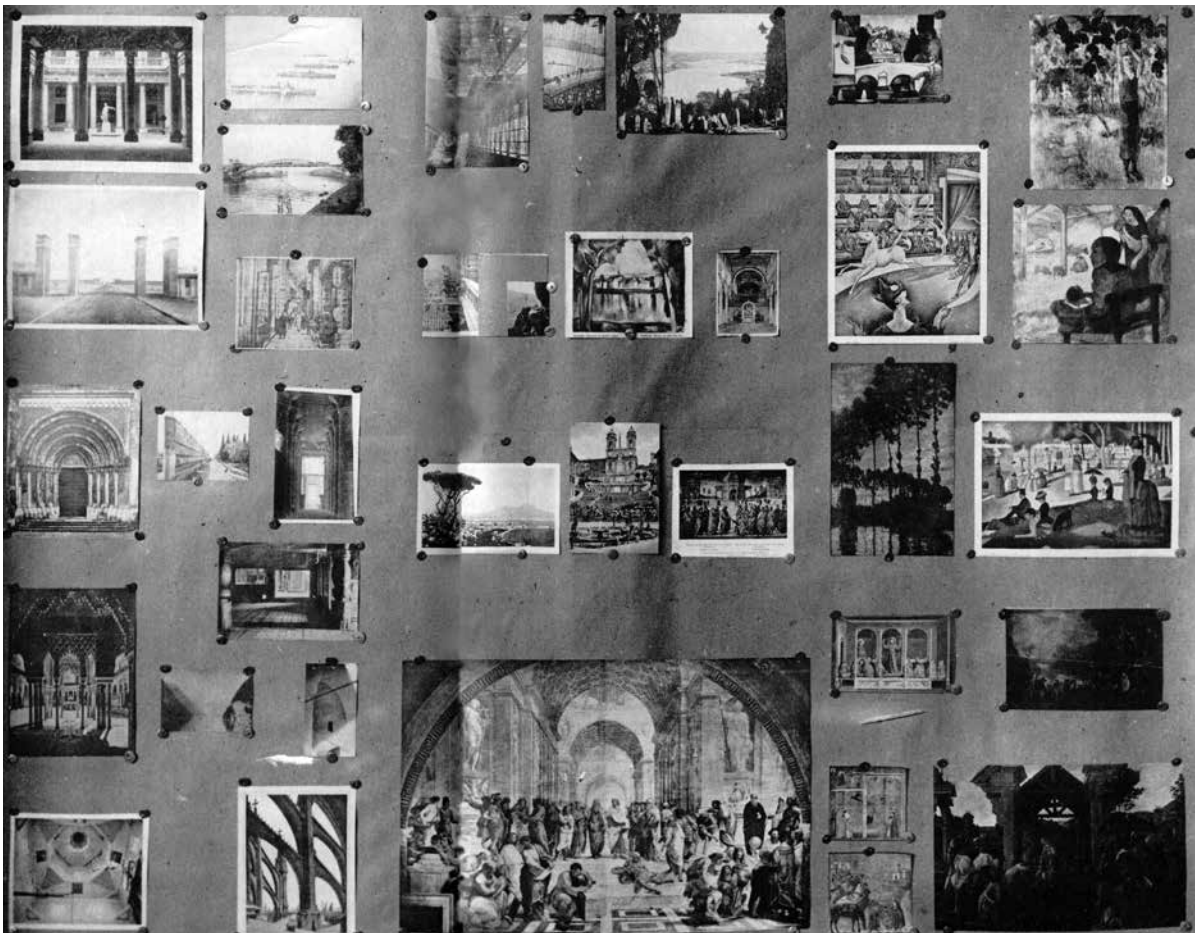
> *Is it acceptable that an architect constructing a form does not know how it would be perceived by a viewer? Such an assumption would mean complete incompetence and the impossibility of any craftsmanship in the field of geometric expression. It is necessary to establish that the architectural geometry of a material form consists of its development in such a way that a spectator really sees its geometric characteristics to a degree necessary for that particular instance [8].*[27]

In other words, Ladovsky argued that architectural education should address fundamental human needs – specifically, perception of and orientation in space – and focus on how to 'organise three-dimensional forms arranged in space.'[28]

The consideration that the tasks in the Space course were meant to be understood as a coherent and consistent whole is also evident in Jakob Kornfel'd's 1926 article published in *Sovremennaja Arkhitektura* (*SA*). Kornfel'd discussed the VKhUTEMAS conference held that November and reported on the content of the Basic division, 'taught by architects who are members of the Association of New Architects (ASNOVA). Their teaching focuses on

the study of form as an independent element and on its perception. It is here that form becomes detached from the entire functional, structural, and technical essence of the object. The study of the "fundamental subjects" – volume, surface, colour, mass, weight, and dimensions – takes place in a context of complete abstraction and is perceived by students as a set of rules for a new metaphysical concept of surface, separated from essence.'[29]

After the assignments were introduced and issued, a foundational phase of the instruction involved the use of visual materials through boards of precedents (stage two). Discussed verbally, these examples served two functions: to provide lessons in architectural and art history and lessons in spatial analysis. They enabled a comparative, pragmatic understanding, focusing on examples of architecture throughout history as well as on natural



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9 **Presentation board of system of visual materials by Ivan Lamtsov during the Space course, c. 1926.**

10 **Pietro Perugino, *The Delivery of the Keys*, 1481–2, fresco, Sistine Chapel.**

and urban environments. This aspect of the learning process continued to help students to progress their imagination from two-dimensional geometry toward more complex spatial thinking and to position their forthcoming three-dimensional model in a wider context.

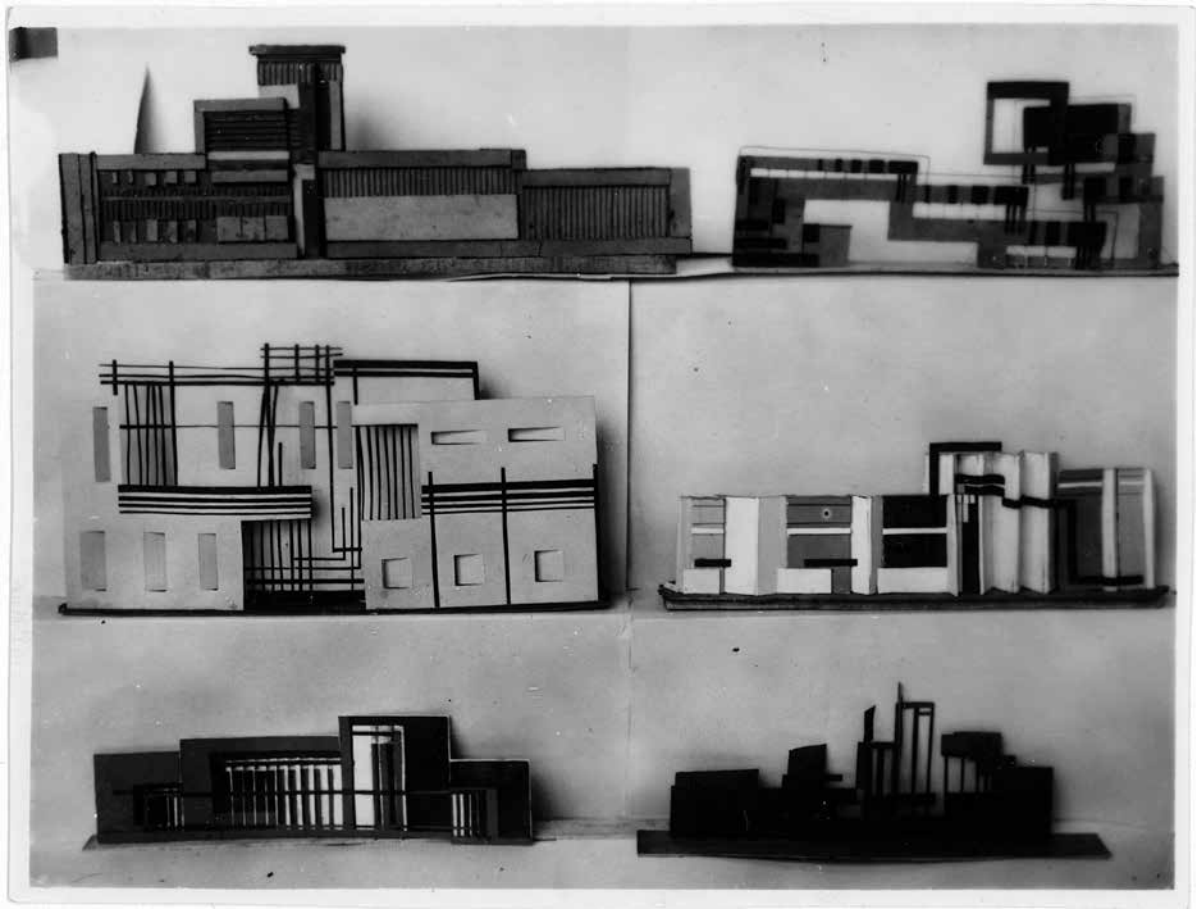
The teachers included different kinds of architectural and spatial forms, such as geometry, size, position in space, mass, texture, and light and shadow, providing a means of spatial analysis of rhythm, composition, scale, and proportion. These were illustrated with numerous architectural examples, covering all historical periods from ancient Egypt, Greece, and Rome, through Romanesque, Gothic, Renaissance, Baroque, Neoclassical, and contemporary architecture. What the instructors searched for in the inclusion of material was its potential to illustrate continuity in history through timeless artistic and architectural concepts. Providing contemporary projects and historical references was not simply a way to resist in the rapidly changing political climate and preserve all that was valuable; rather, it was a way of grounding a position, of contextualising contemporary architectural practice, and of demonstrating the validity of the analytical method as a pedagogical process.

This visual material included photographs of architecture in the Russian tradition, from the churches of Vladimir and Novgorod to the Neoclassicism of Vasily Bazhenov, representing a wide variety of sources. Also visible on one of the boards is the Mirozhsky Monastery (1156), an architectural ensemble of fundamental historical and artistic value for the former Soviet Union and a cathedral prototype of Byzantine architecture.[30] A particularly rich board displayed works of architecture from medieval to contemporary times, through portals, gothic buttresses, and vaults. Landscape paintings and photographs were also featured – including a view of the Gulf of Naples with a typical Mediterranean pine and Mount Vesuvius in the background – as well as details of a memorable urban scene in Rome, the Spanish Steps, and Trinità dei Monti. It also featured several artistic masterpieces, such as Raphael's fresco *The School of Athens* (c. 1510) and other examples of art history that reveal the importance of visual culture for teaching: the geometrically structured frescoes of Giotto at Assisi and of Pietro Perugino in the Sistine chapel (*The Delivery of the Keys*, 1481–2) as well as paintings by Sandro Botticelli in the National Gallery of Art of Washington (*Adoration of the Magi*, c. 1478–82) and by Paul Gauguin and Georges Seurat, the latter being represented by his masterpieces *Sunday Afternoon on the Island of La Grande Jatte* (1884–6) and *The Circus* (1890–91) *[9, 10]*.[31]

Other panels featured architecture from different historical periods and included early Renaissance examples from Florence, such as the Pazzi Chapel (1442–60) and the Palazzo Medici-Riccardi (1444–84), as well as later works like the Palazzo Farnese at Caprarola (1530–75) and Andrea Palladio's transformation of the Palazzo della Ragione into the Basilica Palladiana in Vicenza, which began in 1549 and was posthumously completed.[32] One of the later panels presented students with images of early twentieth-century projects by the Swiss-French architect Le Corbusier, such as the Werkbund and the Weissenhofsiedlung in Stuttgart (both 1927).[33] Le Corbusier's works were featured next to the Derzhprom (State House of Industry) of Kharkiv (1928) designed by Sergei Serafimov,[34] the Rusakov Club by Konstantin Mel'nikov, and the first modern residential developments from Zaporizhzhia to Moscow of 1923–4.[35] The wealth of these historical case studies legitimised the abstract form generation of the tasks, comparing it with significant precedents.[36]

The next step undertaken by students was the actual modelling process (stage three); this represented the core of the course. The challenge was to construct a spatial solution on the basis of the assignment's instructions and with reference to architectural precedents, demonstrating an informed approach. As mentioned earlier, at this stage – following Khan-Magomedov's analysis adopted by Bokov and confirmed by annotations on archival photographs – six different categories of models were identified, corresponding to the six assignments: Surface, Frontal Space, Volumetric Form, Spatial Form, Mass and Weight, and Deep Space. For each task, a number of models are presented here to explain the internal logic of the exercise devised by the teacher and the students' interpretations of it *[11–17]*.[37]

Teaching began to explore three-dimensional expression, using perspective drawing or the model as the primary methods to help students develop their spatial imagination.[38] There is an incremental logic to the six assignments that becomes clear when they are considered in relation to the finished maquettes. From a simple manipulation of two-dimensional geometry in Surface, students progressed to the introduction of variations of foreground and background in Frontal Space. Then the learning process moved on to the exploration of three dimensions, firstly in Volumetric Form – with the evaluation of the impact of a sculptural object and the interaction with its surroundings – then in Spatial Form, which represented the attempt to understand the concept of enclosed space, differentiating the notion of interior/exterior. The following stage, Mass and Weight, tested the pragmatic, technical, and mechanical problems of solids reflecting on how things hold and stand together. Finally, Deep Space, or the capacity of articulating and evaluating several objects in a given space, investigated how different objects generate spatial relationships – essentially, what students would be called upon to understand and take into account as future architects. The research also uncovered additional, less consistent categories. These simply resulted from the imaginations of the students, who produced solutions that do not seem to fit with any of the previous stages (although the starting point was, most probably, one of the assignments). This aspect, alongside the variety of outcomes in each task, confirms how a standardised assignment was very subjectively interpreted.



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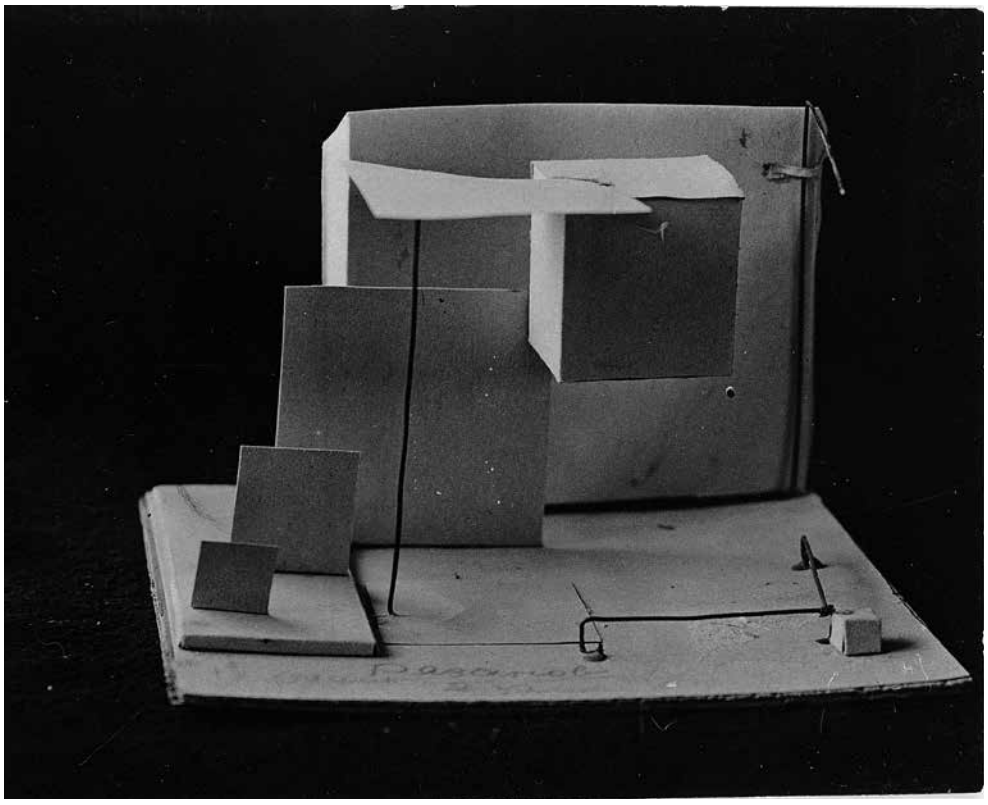

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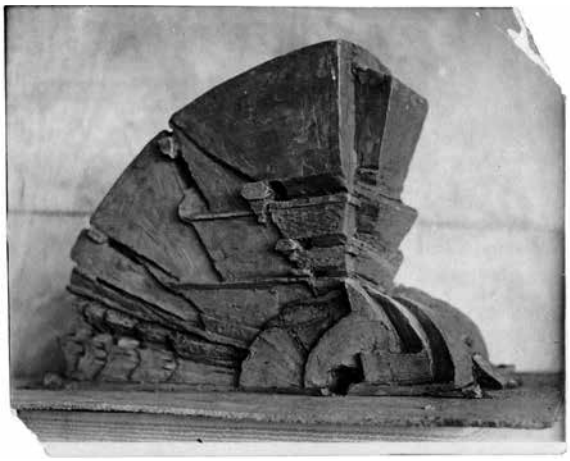
11 **A selection of Surface models produced for the Space course, 1923–7, with the working title: *Construction of Surface based on vertical, horizontal and inclined combination of two or more rhythmical rows*. The selection of models reveals the interplay between vertical and horizontal rhythm, light and shadow, tone and relief.**

12 **A Frontal Space model produced for the Space course with the working title *Frontal Composition*, 1923–7. The student design reveals the interplay between surface elements with a separation of the horizontal surface, frontal composition, and elements of rhythm constructed using card and wire.**

13



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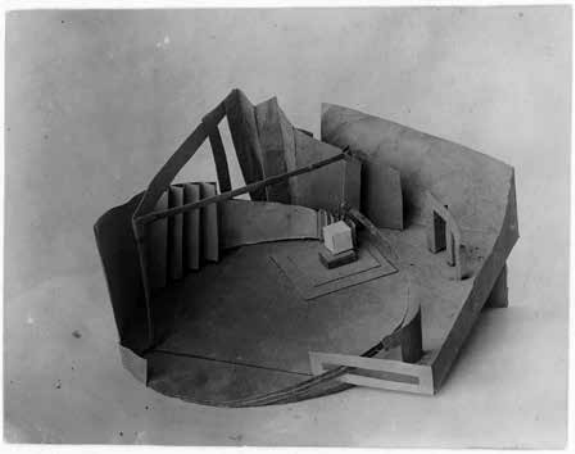

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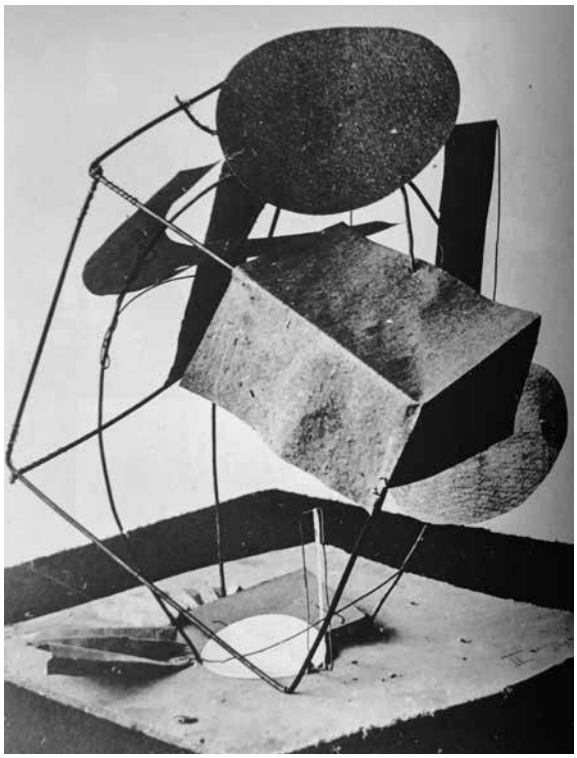

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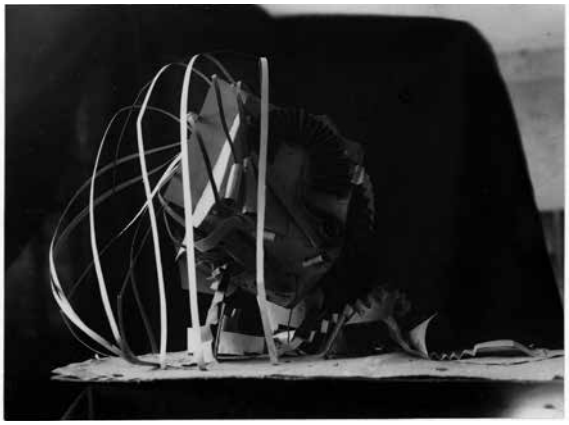

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13 **A Volumetric Form model produced for the Space course with the working title *Constructing and finding a spatial voluminous composition using surface elements*, 1923–7. The model, made in clay, features interlocking surface elements that articulate the separation of form through several planar extrusions.**

14 **A Spatial Form model produced in card and wire for the Space course with the working title *Constructing a cubic form based on combination of mass and space*, 1923–7.**

15 **A Mass and Weight model under the working title *Revelation and expression of Mass and Weight*, c. 1925.**

16 **A Deep Space model produced for the Space course with the working title *Deep Space with strongly emphasised foreground*, 1923–7. The model, constructed using card, portrays different surface positions and elevated forms.**

17 **A model produced as part of the Space course that is not possible to locate in the aforementioned categories, 1923–7. This particular piece explores the *Organisation of Space over a horizontal surface*.**

Many of the models were constructed within a single classroom, the workshop: a compelling setting for the subjective interpretation of architectural teaching that allowed students to develop ideas about construction. The workshop provided an environment that enabled self-exploration, where students were pushed to learn quickly through social interaction within a shared space and to work collectively on projects within a setting where experimentation with new forms of space was encouraged and where mistakes, false starts, and revisions were the norm. During the fabrication of the models, there was a shift in teaching away from individual learning towards dialogue,[39] and stage four (collective discussion) provided a rich setting of cooperative learning, with students voicing a number of different ideas and opinions, developing their spatial knowledge together *[18]*.

18

Intellectual exchanges between students and staff continued in the workshop. While the dialogue among students constituted a form of open spatial assessment and brought together all the prior stages of learning, the relation with staff enabled a greater development of abilities and the correction of shortcomings, with the teacher discussing and commenting on the work in the making, thereby enhancing students' critical skills (stage five). In figure 19, one can see Victor Balikhin – one of the most prominent of the seven teachers who delivered the Space course – analysing a model while more than twenty students listen attentively, showing an influential moment of reflective learning. The blurred photograph depicts objects of various types, many of which were produced as part of the Mass and Weight task; a dozen are delicately positioned on the top shelf of the display unit, revealing noticeable differences of typology, material, and scale *[19]*.

A powerful image dating c. 1927, illustrates eighty-five completed models ready for examination (stage six) *[20]*. Many appear to be made of clay, offering an insight into students' responses to the Volumetric Form and Mass and Weight tasks. On the shelving to the rear are indicated several categories, probably related to different assignments. What is apparent is the difference between each model type, revealing once again how students interpreted the task in a variety of ways. For discussion, models were placed on stools to be viewed and examined at eye level.

The end of year formal exhibition was the last step of the Basic division, where a selection of the work shaped for Space was displayed alongside the wider

19

18 **Students in VKhUTEMAS's workshop, c. 1925. The image shows the environment where discussions took place and captures a range of different clay models, with a strong emphasis on the force of gravity.**

19 **Victor Balikhin discussing students' work, 1923–7.**

20 **Students' models for the Space course at VKhUTEMAS ready for examination, c. 1927.**

21 **Exhibition of works, Space course, c. 1927.**

VKhUTEMAS production (stage seven) *[21]*.[40]

In conclusion, the Space course theorised by Ladovsky and the Rationalists played a crucial role for the avant-garde architectural teaching at VKhUTEMAS between 1923 and 1927. The methodology was devised through a selection of the pedagogical stages identified by Khan-Magomedov, and the early steps of the course allowed students to acquire, with instruction and reflection, thorough spatial knowledge.[41] Students constructed a three-dimensional model from a two-dimensional assignment, exploring options and filling in the gaps with spatial interpretation and imagination. Teachers contextualised their instruction by presenting images of buildings and landscapes as precedents, illustrating the position of analytical methods throughout history. The richness of these precedents provided a diverse collection of architectural and natural examples to be analysed in terms of space, rhythm, composition, and proportion. Students were encouraged to learn from the past, enhancing both their observational and perceptual skills. The integration of references from different historical and geographical contexts

empowered students' creativity, preparing them for the physical crafting of their models. The role of the workshop was central to the success of the Space syllabus – not only for developing ideas through model making, but also for receiving critique from both teachers and peers in a shared setting. Students began model making without knowing the final outcome; the progression toward a result was itself an integral part of the learning process. Archival research highlights a broad spectrum of alternative solutions on a given theme, based on subjective interpretation, before moving on to more complete building projects at the end of the Basic division.

22

This methodology placed significant emphasis on cultivating the individual through spatial design and on sharpening the students' thinking.

The final stage – the exhibition – celebrated students' visions, revealing their early architectural ideas to the broader community within the school. Ladovsky's conception of architecture as a 'spatial subject' shaped a new educational trajectory and the results provided a strong foundation to implement abstract approaches in design. As it has been noted, this 'was also a thankless task, however, because in an epoch orientated towards the idolatry of technology, the exasperation of the role of function in architecture, the ideological ambitions of the architect to assume a central role in the process of revolutionary social change, to speak of space, form, light, and shadow was to speak, essentially, of architecture's *autonomy*.'[42]

A 1927 publication, featuring a striking cover designed by El Lissitzky *[22]*, celebrated several students' works from VKhUTEMAS.[43] That same year, the school was renamed VKhUTEIN (*Vysshiye khudozhestvenno–tekhnicheskii institut,* Higher Artistic and Technical Institute) to emphasise a more scientific focus aligned with the needs of national economic production, resulting in the shortening or elimination of several courses.[44] In 1928, Lunacharsky reflected on the Basic division at VKhUTEMAS, acknowledging that it had fulfilled the original vision he had set for art education:

> *This introductory course in which young people study the elements of art in the form of various subjects (line, colour, space volume, etc.) is a valid example of our research begun rightly after the Revolution.* […] *Now it is absolutely clear that this innovation has put down profound roots and forms a sound methodological base for future successes in our teaching of art.*[45]

More than any other course taught at VKhUTEMAS, Space – complex and constantly evolving – left an enduring impact, not only in the later stages of the

23

22 **El Lissitzky, cover of *Arkhitektura*, 1927.**

23 **Rusakov worker's club by Konstantin Mel'nikov, photographed by Alexander Rodchenko, c. 1929.**

24 Portrait of an unidentified student at VKhUTEMAS, c. 1925.

school as envisioned by Lunacharsky, but also in the built environment of Moscow. The compelling work of Mel'nikov, particularly his 1927–9 Zuev and Rusakov workers' clubs, illustrate – perhaps better than that of any other architecture – the potential of the design principles and ideas advanced through VKhUTEMAS teaching *[23]*. Although Mel'nikov was affiliated with Ladovsky's group for a short period of time, his work demonstrates how the new pedagogy could yield tangible results, extending beyond the walls of one of the most ambitious educational experiments of the twentieth century.[46]

The future of Space

Understanding the sequence and logic of teaching Space at VKhUTEMAS offers an opportunity to reflect on contemporary architectural pedagogy. Ladovsky trained students to explore architecture through its negative – space – and with experimental training methods: visual, cognitive, and perceptual aspects of VKhUTEMAS that remain highly relevant today. To synthetise: spatial imagination, particularly the ability to relate two-dimensional conventions with three-dimensional formulations; the active role of art and architectural history/theory for compositional training and to develop abstract thinking; and the exploration of cognition and perception of space through model making.

The first of the three points – spatial imagination – has been problematic throughout history but becomes even more critical at a moment when computers dominate architectural education. Most pupils learn and develop the basic architectural conventions (plan, section, elevation, modelling) via digital tools; nevertheless, students struggle with translating two-dimensional conventions into three-dimensional spatial thinking —a skill that was central to the VKhUTEMAS curriculum. In his *Architecture as Space*, Bruno Zevi clearly elaborated on this shortfall in the architects' training:

> *The methods of representing buildings most frequently employed in histories of art and architecture consist of (1) plans, (2) façades and elevations and (3) photographs. We have*

> *already stated that neither singly nor together can these means ever provide a complete representation of architectural space.* […] *The box formed by the walls cannot be divided into simple planes or walls independent of each other, because it is a projection of the internal space; the construction is conceived primarily in terms of volumetrics. We are dealing with plastic volumetric conceptions which can be represented only by models.* […] *On the other hand, we cannot say that models are completely satisfactory* […] *because they neglect an element crucial to any spatial conception:* the human parameter – *interior and exterior human scale.*[47]

Zevi gave weight to the educational use of the model, yet defined its limitations. This aspect connects his reflections with one of the main points made by Ladovsky: that the position of the viewer should have been imagined at 1.60 metres and with a dynamic perspective, which should be read in conjunction with the praxis of positioning VKhUTEMAS's models at eye level, to mitigate the embodiment gap.[48]

On the other hand, the strong relationship between architecture and the visual arts at VKhUTEMAS recalls shared principles across different subjects. Painting, alongside its more obvious role as spatial and compositional precedent for architecture, was integrated into process and practice of modern masters such as Le Corbusier and Alvar Aalto. Le Corbusier painted every morning throughout his career, and the structure of his paintings mirrors his architectural thinking.[49] Aalto, in a well-known essay, wrote of the 'sacred links between architecture and the fine arts', asserting that:

> *It can be definitely said that abstract artistic forms have provided a great stimulus to modern architecture – admittedly in an indirect way, but one which cannot be denied as a fact. This stimulus has worked both ways; for architecture too, has stimulated abstract art.* […] *I believe – in fact, I am convinced – that in their beginnings architecture and the other art genres have the same starting point: a starting point which is, admittedly, abstract, but at the same time influenced by all the knowledge and feelings we have accumulated inside us.*[50]

The reciprocal relationship between art and architecture in understanding and composing abstract concepts highlights the importance of artistic literacy within architectural training – something the Space course actively embodied through its methods and that could be meaningfully applied in the teaching of visual arts for architecture students.

Finally, the practice of model making as an exploratory tool is considerably valuable in the contemporary pedagogical context, where students tend to rely on digital software for their design process; but, despite its capacity to simulate depth, the computer screen remains a flat surface. This reliance on screen-based media should be critically examined *vis-à-vis* cognitive and perceptual – as well as tactile – learning.

Historically, since the Renaissance, models have been used to either anticipate or confirm a design, a convention that continues today – when they are rarely used to generate design ideas. This limits their potential: they should not be restrained to representing predesigned outcomes but used as tools for spatial exploration and discovery, representing instruments of spatial thinking in their own right.[51] At VKhUTEMAS, simple exercises involving paper, cardboard, and clay models interpreting geometric principles helped students to grasp spatial relationships through hands-on experimentation. Engaging with the shapelessness and materiality of clay, in particular, enabled them to transcend the familiar and achieve cognitive breakthroughs, leading to the emergence of new forms.

Studio teaching remains the core of architectural education, but the foundational skills mentioned above – spatial imagination, artistic awareness, and experimental model making – must be introduced at the beginning of the educational process, to foster an understanding of the 'how' and 'why' of architecture. As Peter Carl puts it, indeed, studio teaching is based on a practical imagination:

> *Its capacity to mediate between primordial phenomena of materiality and the most abstract concepts, and therefore between concrete judgements and specialised knowledge. The culture of a studio is never simply training: it is not just about developing familiarity with technical problems or inculcating specific design strategies. Much more fundamental are the* how *and the* why *behind such techniques – the capacity to form coherent, perhaps even profound, judgements regarding human purpose, always claimed by diversity in history.*[52]

The three key pedagogical pillars discussed above were at the heart of VKhUTEMAS's Space course. Perhaps it is time to reintegrate such closely connected methods at the outset of architectural education – not as a nostalgic gesture, but as a means of training students to reflect on the spatial implications of their design decisions *[24]*.

Notes

1. This concept can be summarised in Lenin's own words: 'The real education of the masses can never be separated from their independent political, and especially revolutionary, struggle. Only struggle educates the exploited class. Only struggle discloses to it the magnitude of its own power, widens its horizon, enhances its abilities, clarifies its mind, and forges its will'; *Pravda*, 18, 22 January 1925, quoted in Vladimir Lenin, *Lenin Collected Works*, vol. 23 (Moscow: Progress Publishers, 1964), pp. 236–53.
2. Nigel Grant, *Soviet Education* (Middlesex: Penguin Books, 1968), pp. 15–16.
3. Lunacharsky and his advisors embarked on a highly radical reorganisation of education throughout the country where art and creative subjects, in general, were given special focus. See: Sheila Fitzpatrick, *The Commissariat of Enlightenment: Soviet Organisation of Education and the Arts under*

Lunacharsky (Cambridge: Cambridge University Press, 1970).

4. The first point of the 1920 decree stated: 'The Moscow VKhUTEMAS is a specialised educational institution for advanced artistic and technical training, created to produce highly qualified artist–practitioners for modern industry, as well as instructors and directors of professional and technical education'; quoted in Christina Lodder, *Russian Constructivism* (London: Yale University Press, 1983), p. 112. Staff included artists such as Aristarkh Lentulov (1882–1943), Pyotr Konchalovskii (1876–1956), Ilya Mashkov (1881–1944), Alexander Rodchenko (1891–1956) and other members of the painters' association 'Jack of Diamonds'– as well as Kazimir Malevich (1879–1935) and Wassily Kandinsky (1866–1944). Lenin visited the school on 25 February 1921.
5. Anna Bokov, *Avant-Garde as Method: VKhUTEMAS and the Pedagogy of Space, 1920–1930* (Zurich: Park Books, 2020). Bokov names *Osnovnoe otdelenie* the Core division; see also Anna Bokov, 'VKhUTEMAS Training', Pavilion of the Russian Federation, 14th Venice Biennale, 2014, pp. 5–34.
6. The Rationalist movement derived its name from the theory of 'Rational' architecture developed by Ladovsky and his associates. It emerged as an organisation formed by a small group of architects, ASNOVA (*Assotsiatsiia novykh arkhitektorov* / Association of New Architects) and Ladovsky's seminal work, 'Osnovy postroeniia teorii arkhitektury (pod znakom ratsionalisticheskoi estetiki) [The Foundation for Constructing a Theory of Architecture (Under the Banner of a Rationalist Aesthetic)]' was published in *Izvestiia ASNOVA*, 1 (1926), p. 3. For a complete translation, see: Bokov, *Avant-Garde as Method*, p. 248.
7. Initial Rationalist efforts to seek a new theoretical basis for modern architecture revolved around contemporaneous experiments in modern avant–garde art. A connection between the Rationalist attitudes to spatial form through Lazar Markovich Lissitzkii (1890–1941) and his so–called *Proun*, an acronym devised by Lissitzkii from the words *Proyect utverzhdenia novogo* (Project for the Affirmation of the New). In his article 'Proun', published in *De Stijl* in 1922, Lissitzkii asserted that 'Proun advances towards the construction of space, divides it by the elements of all dimensions, and constructs a new many-sided, however, unified image of our nature'; El Lissitzkii, 'Proun', *De Stijl*, 5:6 (1922), 81–5. El Lissitzkii became a member of the ASNOVA group in the mid-1920s.
8. Ladovsky's research simultaneously took three main directions: (1) the collection of existing theories of architecture; (2) the adjustment of theoretical research pertinent to architecture from other subjects; (3) the explanation of the group's own theoretical insights into architecture; see: Maria Gough, *The Artist as Producer: Russian Constructivism in Revolution* (Berkley, CA: University of California Press, 2005). Between 1918 and 1923, Ladovsky conducted a series of experiments both individually and with his students, started at Zhivskul'ptarkh (*Kollectiv zhivopisno–skulpturno–arkhitekturnogo sinteza* / Collective of the Painting–Sculpture–Architectural Synthesis, 1918–19) and Sinskul'ptarkh (*Komissiia skul'pturno–arkhitekturnogo sinteza* / Commission for the Synthesis of Sculpture and Architecture, 1919). The development of Ladovsky and his colleagues would further proceed, in the summer of 1919, to the *Gruppa ob'ektivnogo analiza* (Group of Objective Analysis), followed in 1920 by INKhUK (*Institut khudozhestvennoi kul'tury* / Institute of Artistic Culture). The Zhivskul'ptarkh speculations tended to concentrate less on the articulation of volume than on the manipulation of planes, while the principal goal of INKhUK was to systematise the emerging modern movement into a scientifically-based programme for educational and research purposes, considering it in relation with psychology and perception. See: Selim O. Khan-Magomedov, *U istokov formirovaniia ASNOVA i OSA-dve arkhitekturnye gruppy INKhUKa* [*At the Roots of the Formation of ASNOVA and OSA: Two Architectural Groups of INKhUK*] (Moscow: Arkhitektura, 1994), p. 175.
9. See: Luka Skansi, 'The "Restless Allure" of (Architectural) Form: Space and Perception between Germany, Russia, and the Soviet Union', in *The Baroque in Architectural Culture, 1880–1980*, ed. by Andrew Leach, John Macarthur, Marteen Delbeke (Farnham: Ashgate, 2015), pp. 43–60. Ladovsky's made the first public reflection on his theory of Space in 1920 during the Second Independent State Artistic Workshops (SGKhM) in Moscow, when the School of Architecture was still run by traditionalists. Unknown to anybody in the audience, Ladovsky explained the drawbacks of the old stylistic academic approach to architectural education, which he condemned as a passive imitation that kills live imagination and destroys one's desire to apprehend the real laws and methods of architectural creation. See: Selim O. Khan-Magomedov, *Ratsionalizm (ratsio-arkhitektura) 'Formalizm'* [*Rationalism* (*Ratio-Architecture*) '*Formalism*'] (Moscow: Arkhitektura-S, 2007), pp. 140–43.
10. Ladovsky was inspired in his intellectual speculations by the work of the German-American psychologist Hugo Münsterberg (1863–1916). The earliest explicit use of the term 'space' as an architectural category has been dated to the early 1890s and attributed to a group of German aesthetic philosophers; see: Christina Malathouni, 'Architecture is the Pattern of Human Mind in Space: Claude F. Bragdon and the Spatial Concept of Architecture', *The Journal of Architecture*, 18:4 (2013), 553. Its adoption is strictly connected with the development of Modernism, just like 'Form' and 'Design'; see: Adrian Forty, *Words and Buildings: A Vocabulary of Modern Architecture* (London: Thames and Hudson, 2000), pp. 256, 265.
11. Vladimir Krinsky quoted in Selim O. Khan-Magomedov, *Rodchenko: The Complete Works* (Cambridge, MA: MIT Press, 1986), p. 42.
12. Anatole Senkevitch Jr, 'Aspects of Spatial Form and Perceptual Psychology in the Doctrine of the Rationalist Movement in Soviet Architecture in the 1920s', *Architecture and Visual Perception: The Journal of the Graduate School of Fine Arts, University of Pennsylvania*, 6 (1983), 78–115; Selim O. Khan-Magomedov, *Psikhoanaliticheskiĭ metod N. Ladovskogo vo VKHUTEMASe–VKHUTEINe: ob"edinennye levye masterskie; psikhoanaliticheskaia laboratoriia* [*The Psychoanalytic Method of N. Ladovsky at VKhUTEMAS–VKhUTEIN: United Left Workshops; The Psychoanalytic Laboratory*] (Moskva: Arkhitektura, 1993); Selim O. Khan-Magomedov, *Pioneers of Soviet Architecture: The Search for New Solutions in the 1920s and 1930s* (London: Thames and Hudson, 1987); see also: Alla Vronskaya, 'Composing Form, Constructing the Unconscious: Empiriocriticism and Nikolai Ladovsky's "Psychoanalitical Method" of Architecture at VKhUTEMAS', in *Architecture and the Unconscious*, ed. by John Shannon Hendrix and Lorens Eyan Holm (Farnham: Ashgate, 2016), pp. 77–96.
13. OBMAS was devised to provide for a gradual increase in the difficulty of 'abstract' problems in spatial forms and the psychoanalytical methods used as a design tool for generating form, by developing a process of teaching without precedent. Bokov translates seven incremental early exercises extracted from Khan-Magomedov's research; see: Bokov, *Avant-Garde as Method*, pp. 376–83.
14. Elena Ovsyaannikova and Vladimir Shukhov, 'Phenomenon of the

Russian Avant–Garde Moscow Architectural School of the 1920s', *Docomomo Journal*, 49 (2013), 23–4. For further reading on each of the four subjects, see: Selim O. Khan–Magomedov, *VKhUTEMAS, Moscou 1920–1930*, vols 1, 2 (Moscow/Paris: du Regard, 1990), pp. 209–331.

15. Bokov, *Avant-Garde as Method*, p. 160. Favorsky served as rector at *VKhUTEMAS* in 1923–6; he followed Efim Ravdel's term (1920–23); see: Natalia Adaskina, 'The Place of Vkhutemas in the Russian Avant-Garde', in *The Great Utopia: The Russian and Soviet Avant-Garde 1915–1932* (New York, NY: Guggenheim Museum, 1992), p. 286; the authors are grateful to Natalia Adaskina, who studied VKhUTEMAS since the 1960s, for her advice and for generously sharing her unpublished manuscript on the subject.
16. Bokov, VKhUTEMAS Training', pp. 12–34, where the curriculum at VKhUTEMAS is outlined.
17. 'Architecture operates by means of properties – like weight, density, mass, finiteness and non-finiteness, stability or dynamics, etc. – in specific quantities. The architect constructs a form, bringing together elements that are not technical or utilitarian ones in the normal sense of those words, but which can be looked upon as "architectural motifs". In the architectural respect these "motifs" must be rational and must serve the higher technical demand of the individual to orientate himself in space'; Ladovsky ('The Foundation for Constructing a Theory of Architecture') quoted in Bokov, *Avant-Garde as Method*, p. 248. Ladovsky suggested four specific qualities of expressiveness for the purpose of architectural teaching: (1) Geometrical: relationship of the sides, edges, angles, characteristics of surface, etc.; (2) Physical: weight, density, mass, etc.; (3) Physico-mechanical – stability, mobility, etc.; (4) Logical: expressiveness of surfaces, character as such and of delimiting volumes. According to the expressiveness, sizes and quantity we may speak of: (a) strength and weakness; (b) greatness and smallness; (c) finiteness and non-finiteness. See: Nikolai Ladovsky, 'The Foundation for Constructing a Theory of Architecture', p. 3 and Milka Bliznakov, 'Nikolai Ladovsky: the search for a Rational Science of Architecture', *The Soviet and Post–Soviet Review*, 7:1 (1980), 170–96.
18. Natalia Adaskina, unpublished manuscript (see note 15), n.p.
19. Éva Forgács, *The Bauhaus Idea and Bauhaus Politics* (Budapest: Central European University Press, 1995), p. 188.
20. Anna Bokov, 'Vkhutemas and the Bauhaus: On Common Origins and Creation with Fire', in *Dust and Data: Traces of the Bauhaus across 100 Years*, ed. by Ines Weizman (Leipzig: Spector Books, 2019), p. 254.
21. Skansi, 'The "Restless Allure" of (Architectural) Form', pp. 49–58.
22. Khan-Magomedov, *VKhUTEMAS, Moscou 1920–1930*, p. 526, where the Space course is outlined over forty-five weeks in two years; and Magomedov, *Rationalism* (*Ratio-Architecture*) '*Formalism*', where he mentions more than twenty-five pedagogical descriptions.
23. For the Space course, Bokov drew a distinction between the assignment itself – viewed as an essentially abstract proposition – and the subsequent physical realisation of the model; see: Bokov, *Avant-Garde as Method*, pp. 386, 414. Bokov states that 'once students completed this abstract preliminary cycle, they proceeded to work on the production exercises on the six topics' (p. 386). However, in practice, these tasks were experienced as a continuum rather than as separate exercises. Assignments and examples of student work from the course in Krinsky and others are positioned in the book at the end of a thorough analysis of historical precedents that intertwined with geometrical speculations; Vladimir Krinsky, Ivan Lamtsov, Mikhail Turkus, *Elementy arhitekturno–prostranstvennoj kompozitsii* [*Elements of Architectural–Spatial Composition*] (1934; repr. Moscow: Gosstroiizdat, 1938, 1968), pp. 137–72.
24. Bokov, *Avant-Garde as Method*, pp. 384–404; the example by Lamtsov used in the main text is p. 398. Several Space assignment drawings issued by Ivan Lamtsov, including the example published on this occasion, were accessed in 2014 during a visit to the Moscow School of Architecture (MARKhI) Archive, VKhUTEMAS Collection.
25. Bokov, *Avant-Garde as Method*, p. 398, also for the complete English translation of the assignment.
26. Ladovsky, 'The Foundation for Constructing a Theory of Architecture', quoted in Bokov, *Avant-Garde as Method*, p. 248.
27. Ibid.
28. Quote from Ladovsky in Skansi, 'The "Restless Allure" of (Architectural) Form', p. 52 (emphasis in Skansi's text). See also: Luka Skansi, 'Nikolaj Ladovskij: "Spazio", corso base al Vchutemas, Mosca 1920', *Casabella*, 847 (2015), 3–19; English translation, pp. 108–11.
29. *SA Sovremennaja Arkhitektura 1926–1930*, ed. by Guido Canella and Maurizio Meriggi (Bari: Edizioni Dedalo, 2007), pp. 119–20; texts in Italian, English translation by the authors. In the same article Kornfel'd recalled a forthcoming drawing course taught by Vesnin for the academic year 1926–7 defining its role in the service of Space: 'The [drawing] program aims to develop, from every point of view, the understanding of space and the learning of methods for perceiving and conveying volume, surface, colour, and form. Above all, it seeks to study the relationship between the internal composition of things and the form that expresses this composition externally. According to this approach, the teaching of drawing becomes an inseparable part of architectural education' (p. 120).
30. Bokov, *Avant-Garde as Method*, p. 202.
31. Ibid., pp. 198–9.
32. Canadian Centre for Architecture, Montreal, PH1998:0014:010.
33. Le Corbusier had a brief relationship with the Soviet Union, starting with his first trip to Moscow in 1928 and concluding with the rejection of his proposal for the Palace of the Soviets competition bid in 1932. For further reading, see: Jean-Louis Cohen, *Le Corbusier and the Mystique of the USSR: Theories and Projects for Moscow, 1928–1936* (Princeton, NJ: Princeton University Press, 1992).
34. Built between 1925 and 1928, Derzhprom represented the aspirations of the Soviet avant garde of the 1920s. The works presented on the board, on a similar scale, were later published in the propaganda magazine *USSR in Construction*, published between 1930 and 1941 (and in 1949), whose principal mission was to promote a positive image of the Soviet Union abroad.
35. Presentation board used for analytical purposes during the Space course after 1928, currently at the Canadian Centre for Architecture, Montreal, PH1998:0014:010. During the 1920s Mel'nikov, through ASNOVA, associated himself with the Rationalists and VKhUTEMAS.
36. Krinsky and others, *Elements of Architectural–Spatial Composition*, pp. 135, 137.
37. Many of the photographs provide little or no student names on the verso, nor the authors of the image, but often crucial information on the title of the task. Description findings can be concurred through selected works by Magomedov, *Rationalism* (*Ratio-Architecture*) '*Formalism*', pp. 258–73. The exercises evolved in four tasks after 1927, namely Surface, Volume, Mass, and Spatial Form; see: Bokov, *Avant-Garde as Method*, p. 386.
38. The first reference to sculptural modeling was David Yakerson's (1896–1974) studio at Vitebsk

People's Art School (1918–22). Yakerson was one of the first in Russia to produce abstract constructions as part of an art pedagogy: his students were required to create three dimensional compositions using real materials, paving the way for the introduction of objective methods in Vitebsk and in the Russian capital. In the United States, Columbia University School of Architecture later became one of the first institutions to introduce model making into the architectural curriculum between 1920–21, and since then, the use of models increasingly became an integral part of architectural education at the school; see: William Boring, 'Use of Models in the Study of Architecture', *Architecture: The Professional Architectural Monthly*, 45, 1922, pp. 200–02. William Boring (1859–1937), director of the School of Architecture at Columbia University at the time, describes the staff of his department helping students to develop detailed models in clay (p. 202). See also: Davide Deriu, 'Transforming Ideas into Pictures: Model Photography and Modern Architecture', in *Camera Constructs: Photography, Architecture and the Modern City* (Farnham: Ashgate, 2012), pp. 159–78.

39. Selim O. Khan–Magomedov, *Viktor Balikhin* (Moscow: Russkii Avangard, 2009).
40. Exhibition photographs for the 1923–7 period are very rare. Earlier and later images show a formal setting for exhibitions both at OBMAS and VKhUTEIN; see, for example: the 1922 and c. 1928 photographs published in Bokov, *Avant-Garde as Method,* pp. 17, 618–24.
41. In Khan-Magomedov's publications, the presence of the term 'discussion' suggests that instructions were not prescriptive but open to interpretation through dialogue between teacher and pupil.
42. Skansi, 'The "Restless Allure" of (Architectural) Form', p. 58; emphasis in the original.
43. *Arkhitektura: Raboty arkhitekturnogo fakulteta Vkhutemasa, 1920–1927* [*Architecture: Works of the Architecture Faculty of VKhUTEMAS, 1920–1927*] (Moscow: Izd-vo Vkhutemasa, 1927).
44. *From VKhUTEMAS to MARKhI 1920–1936: Architectural Projects from the Collection of MARKhI Museum* (Moscow: A–Fond Publishers, 2005).
45. Anatoly Lunacharsky, *Izvestiya VTsIK* (May 1928), quoted in Khan-Magomedov, *Rodchenko: The Complete Works*, p. 105.
46. *Konstantin S. Mel'nikov and the construction of Moscow*, ed. by Mario Fosso, Otakar Máčel, Maurizio Meriggi (Skira: Milan, 2000), pp. 164–81. For architectural design as physical history, see: *Designs on History: The Architect as Physical Historian*, ed. by Jonathan Hill (London: RIBA Publishing, 2022).
47. Bruno Zevi, *Architecture as Space* (New York. NY: Horizon Press, 1957), pp. 46, 56; emphasis in the original text.
48. Ladovsky, quoted in Bokov, *Avant-Garde as Method*, p. 248.
49. Colin Rowe and Robert Slutzky, 'Transparency: Literal and Phenomenal', *Perspecta*, 8 (1963), 45–54; Marco Iuliano, 'Montage d'Orient', *L'invention d'un architecte: Le voyage en Orient de Le Corbusier*, XVII Rencontre de la Fondation Le Corbusier (Paris: Éditions de la Villette, 2013), pp. 414–23.
50. Alvar Aalto, 'Architettura e arte concreta', *Domus*, 223–5 (1947), 103–15; English translation in Göran Schildt, *Alvar Aalto in His Own Words* (New York, NY: Rizzoli, 1997), pp. 107–09.
51. Bradley Starkley, 'Architectural Models: Material Intellectual Spiritual', **arq**: 9:3–4 (2005), 266. On the unconventional use of the model, see also: Nat Chard, 'Instrument of Uncertain Occupation', *DMJournal*, 2 (2024), 114–46, who mentions Ladovsky's 'experiments to test the eye's accuracy in measuring line angles and planes' and more elaborate instruments 'for testing the volumetric and spatial properties of form' (p. 116).
52. Peter Carl, 'The Architectural Studio in a Research University', *Compendium: the Work of the University of Cambridge Department of Architecture* (Cambridge: Cambridge University Press, 2006), p. 49.

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The authors declare none.

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