



ADVERTISEMENT BROCHURE FOR THE KRAUS WINDOW BY THE PODHAJSKÝ COMPANY. CURIOUSLY, THE BUILDING DISPLAYED, THE GENERAL PUBLIC INSURANCE INSTITUTE IN PRAGUE, WAS NOT ACTUALLY EQUIPPED WITH KRAUS WINDOWS.

REKLAMNÍ BROŽURA OKNA KRAUS OD FIRMY PODHAJSKÝ. BUDOVOU V POZADÍ JE PRAŽSKÝ VŠEOBECNÝ PENZIJNÍ ÚSTAV, V NĚMŽ PŘITOM OKNA KRAUS NIKDY NAMONTOVÁNA NEBYLA.

Source Zdroj: Překlápeč ocelová okna patentu Krausova. 1937. Rosice Mining Company, carton 64, no. 86. Moravian Provincial Archive

From Kraus to Orbis: The Two Window Designs of Armin Kraus between Vision and Practicality

Od okna Kraus k oknu Orbis: dva návrhy Armina Krause mezi vizí a praktičností

Alexander Kuric

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První okno bratislavského zámečníka Armina Krause, jehož návrh pocházel z konce dvacátých let, bylo unikátní posuvně-sklpným způsobem otvírání a netypickou kombinací ocelového rámu s dřevěnými těsnicími vložkami. Okno se skládalo ze dvou, ev. tří spojených křídel, z nichž jedno se v rámu otáčelo o 180° a tím za sebou táhlo křídla posuvná. Při úplném otevření se křídla složila na sebe v rovině rámu a nezabírala tak žádný prostor vně ani uvnitř místnosti. Systém měl vertikální i horizontální variantu a nabízel architektům bohaté možnosti kombinace do větších celků se zahrnutím rovněž dveří, větracích nadsvětlíků a podobně. Kombinací materiálů pak Kraus usiloval o spojení subtilnosti, velkorysých dimenzí a tvarové stálosti ocelových oken s dokonalejšími těsnicími schopnostmi dřeva. V očích architektonické avantgardy se tento design stal reprezentantem ideálu technicky dokonalého moderního okna, splňujícího požadavky na štíhlost, mechanickou dokonalost, důmyslné větrání, výrobní preciznost a prostorově úsporný mechanismus otvírání. Tato poslední vlastnost byla zvláště důležitou v souvislosti s tou dobou aktivně diskutovanou otázkou minimálního bytu. Ve svých realizacích i textech tak členové avantgardy, mj. Bohuslav Fuchs nebo Karel Teige, věnovali oknu značnou pozornost, k čemuž jim firma Kraus ochotně sekundovala aktivní reklamou. V ní bylo okno prezentováno jako odpověď na všechny požadavky moderního stavitelství, ať již v prospektech, na stránkách časopisů, či v souborném katalogu stavebních firem. Okna se dokonce objevila i na výstavě CIAMu v Bruselu roku 1930 a brněnské Výstavě stavebnictví a bydlení v roce 1933.

Avšak tato propagovaná technická dokonalost byla blíže ideálu než realitě. Přestože jednou z motivací pro volbu materiálů a konstrukce byla snaha o dosažení dokonalejší těsnosti, než jaké dosahovala běžná kovová okna, právě hledisko utěsnění bylo u okna Kraus problematické a mířilo na něj četné stížnosti zákazníků. Řešení, při němž utěsnění měla zajišťovat kovová lišta zasouvající

se do dřevěných vložek, se v praxi ukázalo nedostatečně spolehlivým a vyžadovalo vkládání dodatečných těsnění. Poměrně složitá konstrukce, velká hmotnost a použité drahé materiály navíc byly příčinou vysoké prodejní ceny okna, téměř dvojnásobně vyšší než u obyčejných oken dřevěných. Jako mnohé jiné technické novinky této doby bylo tak zajímavé spíše pro náročné a solventní zákazníky, kteří ovšem měli o to menší ochotu tolerovat jeho technické nedostatky. Ačkoli tedy bylo okno Kraus pozitivně přijato představiteli architektonické avantgardy, jako komerční produkt mělo recepci méně nadšenou. Na vině ovšem nebyly pouze vlastnosti okna, ale také jeho nešťastné načasování. Hospodářská krize, která vypukla nedlouho po uvedení okna na trh, podobně náročnému a nákladnému výrobku pochopitelně nepřála. Okno bylo od počátku třicátých let vyráběno také v české polovině státu, v licenčním držení Rosické báňské společnosti. K tomuto ujednání původně Krause motivovaly slibné obchodní začátky. Avšak klesající zájem a dlouhodobě ztrátová operace nakonec přinutily českou firmu výrobu oken, z nichž právě Kraus tvořilo hlavní položku, roku 1935 zcela ukončit. S nepříznivými ekonomickými výsledky a těžkými časy pak musela zápat i sama bratislavská firma Kraus.

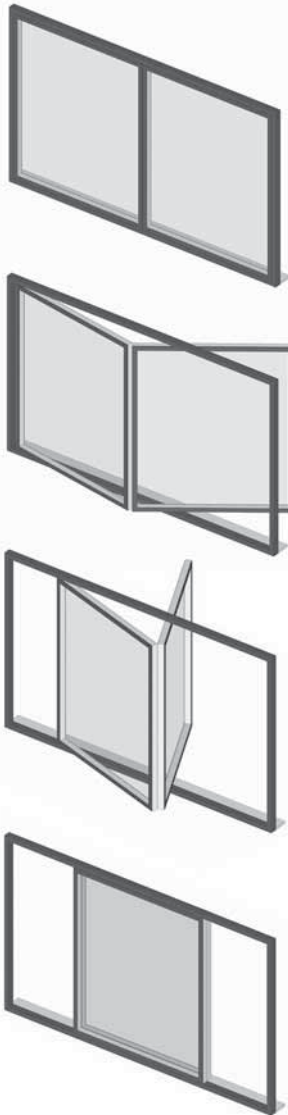
Tento vývoj motivoval Armina Krause k tomu, aby se vrátil k rýsovacímu prknu a své okno radikálně přebudoval. Tak vzniklo roku 1934 druhé patentní okno, nesoucí název Kraus-Orbis. To bylo oproti prvnímu v mnoha ohledech zjednodušeno. Sklopně-posuvný systém otvírání byl nahrazen vlastně mechanismem posuvným, který si přesto zachoval několik unikátních aspektů. V zavřeném stavu se obě křídla nacházela ve stejné rovině a k posunutí jednoho bylo nutné druhé křídlo nejprve vysunout směrem do interiéru; tento pohyb zároveň sloužil jako větrací poloha okna. Současně měl uživatel možnost obě křídla otevřít na otáčivých závěsech a celý prostor okenního rámu úplně uvolnit, což u prvního okna možné nebylo. Tak si okno Orbis nejen ponechalo výhodu prostorově úsporného otvírání okna prvního, ale dokonce ji obohatilo o další možnost. Problematické zasouvací těsnicí lišty pak byly zcela odstraněny a nahrazeny kontaktním dorazem křídla na rám v několika těsnicích rovinách, tedy způsobem používaným u běžných oken s otvíravými křídly. Dřevěné vložky z původního designu v konstrukci nového okna zůstaly, avšak nově jako součást rámu, nikoli křídla. V detailu bylo navíc okno lehčí a úspornější a zejména v tvarování a kombinaci ocelových profilů dosáhlo značného zjednodušení, což dovolilo snížit prodejní cenu.

Celkově se tedy v oknu Orbis podařilo Krausovi vytvořit zdokonalený výrobek, který mnohé závady svého předchůdce odstranil a sliboval konečně dosáhnout kýžený komerční úspěch. Avšak události, které jeho tvůrce nemohl předvídat, úspěchu okna nepřály. V roce 1934, kdy bylo okno uvedeno na trh, stavebnictví stále ještě trpělo krizí. I když bylo okno Orbis cenově dostupnější než původní okno Kraus, stále šlo o poměrně složitý výrobek z dražšího materiálu a starým dřevěným oknům konkurovat nemohlo. Jeho obchodní počátky tak byly obtížné. Když později důsledky krize začaly opadávat, Kraus byl stále omezen původními licenčními ujednáními s Rosickou báňskou společností, která však mezitím okna přestala vyrábět, a byl nucen investovat nemálo času do hledání nového obchodního partnera. Po tuto dobu mohla být okna vyráběna pouze v Krausově vlastní továrně. Nedlouho poté, co nového výrobce roku 1937 konečně našel ve firmě Podhajský, byl ale nucen čelit další komplikaci v podobě patentního sporu s konkurenčním, téměř identickým oknem Cristal. Než mohla být záležitost definitivně rozřešena, došlo ke známým politickým převratům, které Krause přinutily opustit jeho továrnu i domovskou zemi. Ani k jednomu se již nevrátil. Série nepředvídatelných obtíží tak nedovolila oknu Orbis naplnit jeho potenciál, a přes svá nesporná technická zdokonalení tak zůstalo okrajovým fenoménem, jenž nikdy nedosáhl ani úspěchu okna prvního.

Introduction

“More light and air!” proclaimed the advertisement brochure for the Kraus window, one of the most interesting window designs produced in interwar Czechoslovakia. This construction element appeared on several important Modernist structures in Bratislava, Brno and Prague, and was favored by several well-known pioneers of the architectural avant-garde. These unique windows have already been subject to the attention of researchers in connection with conservation efforts,¹ and recently more detailed research was conducted regarding their spread, the life path of their creator, Armin Kraus, and the historical and

architectural context in which the invention arose, including later developments involving collaboration with several Czech manufacturers.² In terms of technical specifics, the essence of the Kraus window design has already been described as well,³ though their unique character deserves an even closer look. However, the design was not without its technical issues, and the way they manifested themselves, as well as the resulting impact on the window as a market product and the subsequent responses from the window’s inventor, eventually leading him to creating an entirely new design, are tightly intertwined with its history. The story of Kraus and his windows illustrates the



THE OPENING METHOD OF THE KRAUS WINDOW

ZPŮSOB OTVÍRÁNÍ OKNA KRAUS

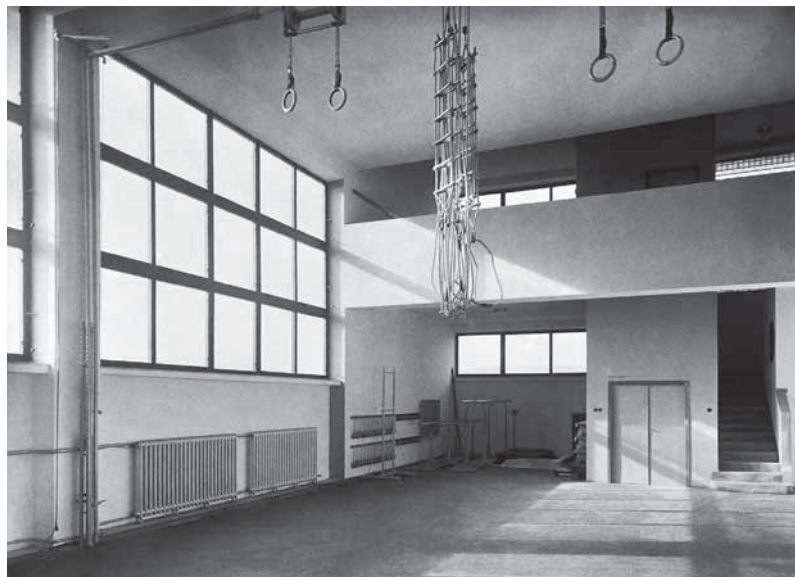
Author Autor: Alexander Kuric



THE VERTICAL VARIANT OF THE KRAUS WINDOW ON THE VILLA OF DR. CHOCHOLÍN, DESIGNED BY MILOSLAV KOPŘIVA, BABA COLONY, PRAGUE

VERTIKÁLNÍ VARIANTA KRAUSOVA OKNA NA VILE DR. CHOCHOLÍNA, NAVRŽENÉ MILOSLAVEM KOPŘIVOU V KOLONII BABA

Photo Foto: Matúš Dulla



KRAUS WINDOWS ARRANGED INTO A LARGER UNIT ON THE BUILDING OF THE VESNA GIRLS' SCHOOL, BRNO, DESIGNED BY BOHUSLAV FUCHS AND JOSEF POLÁŠEK

VELKÁ SESTAVA KRAUSOVÝCH OKEN NA BUDOVĚ DÍVČÍ ŠKOLY VESNA V BRNĚ OD BOHUSLAVA FUCHSE A JOSEFA POLÁŠKA

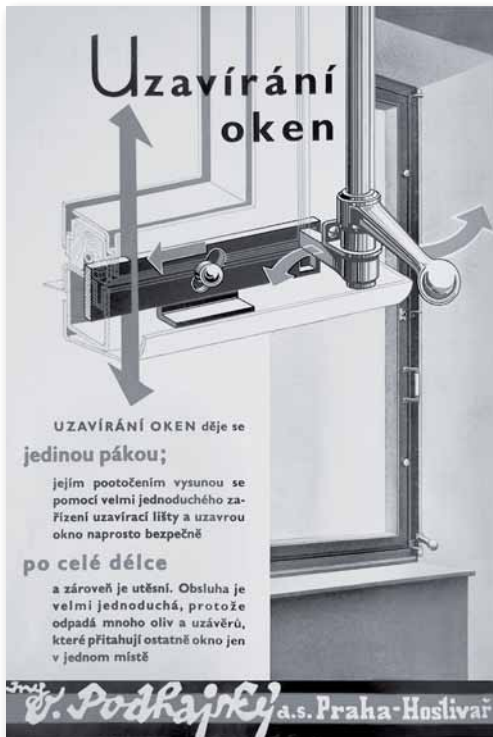
Source Zdroj: FUCHS, Bohuslav, 1936. Několik ukázek novodobých školních budov. Brno: Bohuslav Fuchs vl. n.

peculiar dichotomy between the visionary spirit surrounding many Modernist technical inventions and their often more problematic practical performance.

The Kraus Window: A Complicated Technical Creation

As Henrieta Moravčiková stated, the design of the Kraus window was unique in two aspects: one being its sliding and pivoting way of opening, the other its combination of a steel frame with wooden infills. The window was divided in two or three sashes, one of which pivoted by 180 degrees with the other(s) joined to it by hinges on the side, sliding along as the center sash was rotating. The arrangement of the opening mechanism could be both vertical and horizontal, meaning that the

rotating sash could have either a vertical or horizontal axis;⁴ in the latter case, a selling point was that the mechanism required no counterweights,⁵ otherwise found in typical sash windows. When fully open, all sashes were stacked on top of one another in the same position, inside the plane of the frame, meaning that the opened windows did not occupy any interior space, unlike regular casement windows. The window was manipulated by a single lever and a fixed handle by which the user grabbed and rotated the pivoting sash. A much more elegant solution than the typical wooden windows of the time, which often had multiple separate locking handles that needed to be opened individually and could be sometimes difficult to reach, it meant greater ease of use, which in fact formed one of the strong points marketed in Kraus advertisement brochures.⁶ For double



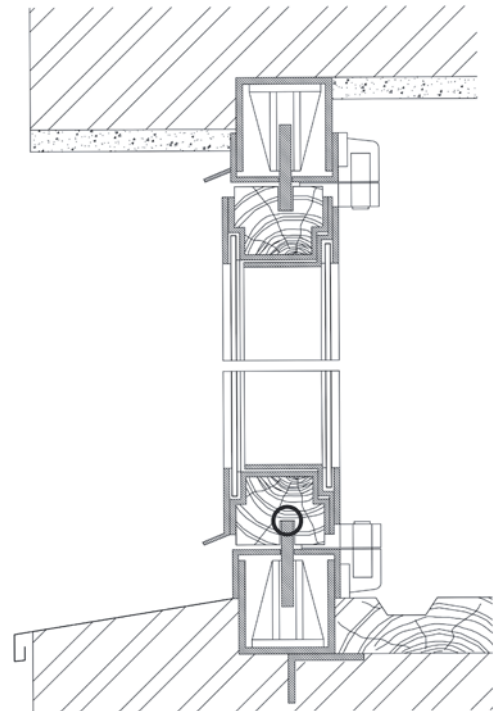
A PAGE FROM THE PODHAJSKÝ MARKETING BROCHURE, SHOWING THE MANIPULATION LEVER OF THE KRAUS WINDOW. THE TEXT DESCRIBES ITS OPERATION AND THE METAL LOCKING STRIP.

STRÁNKA Z REKLAMNÍ BROŽURY FIRMY PODHAJSKÝ UKAZUJÍCÍ FUNKOVÁNÍ OVLÁDACÍ PÁKY KRAUSOVA OKNA

Source Zdroj: Překlápěcí ocelová okna patentu Krausova, 1937. Praha, Ing. O. Podhajský, Rosice Mining Company, carton 64, no. 84. Moravian Provincial Archive

glazing, each sash pane could also be opened to allow cleaning of the glass from the inner side. Additionally, the window could be equipped with ventilation grilles on top or a fixed, unopenable upper pane, and arranged into larger setups made of several window units, as seen, for example, in the building of the Vesna girl's school in Brno. The units themselves, in turn, could be manufactured to any dimensions, though several standard sizes were offered.⁷

The second unique property of the window lay in the combination of a steel frame with infill beams made of oak. Unlike the opening system, this feature was not subject to patent protection.⁸ The purpose of the wooden beams inserted into the U-shaped steel sash frames was to improve the window's draught proofing and longevity, both of which, the advertising claimed, were frequent problems of regular steel windows, where the contact between two metal surfaces created an imperfect seal and eventually sealed to wear.⁹ In the case of the Kraus window, optimal draught proofing was to be achieved by a movable steel bar in the bottom and top jambs of the frame, which after switching the manipulation lever would slide into



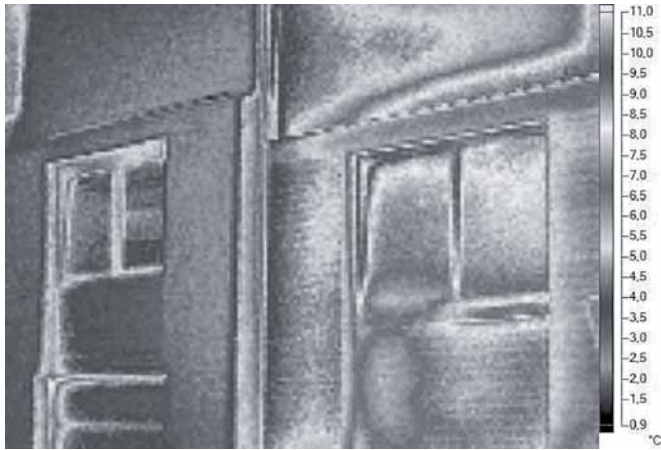
VERTICAL CROSS-SECTION OF THE KRAUS WINDOW. NOTICE THAT THE DESIGN ONLY CREATES ONE SEALING AREA OF CONTACT (MARKED BY A CIRCLE), AS OPPOSED TO TYPICAL WINDOW DESIGNS OF THE TIME, WHICH WOULD HAVE MULTIPLE CONTACTS. THIS MADE THE DESIGN MORE VULNERABLE FOR WEATHERPROOFING. LATER, MANUFACTURERS OF THE WINDOW WOULD TRY TO IMPROVE IT BY ADDING FLEXIBLE SEALING MATERIALS TO THIS CRITICAL PART.

SVISLÝ ŘEZ OKNEM KRAUS. NA KRESBĚ JE PATRNÉ, ŽE OKNO KRAUS MĚLO POUZE JEDNU KONTAKTNÍ PLOCHU MEZI KŘÍDLEM A RÁMEM (OZNAČENA KROUŽKEM). TO BYLO PŘÍČINOU PROBLEMATICKÉHO UTĚSNĚNÍ – BĚŽNÁ DŘEVĚNÁ OKNA MĚLA KONTAKTNÍCH PLOCH NĚKOLIK ZA SEBOU. POZDĚJI BĚHEM VÝROBY SE V KOUTU DRÁŽKY ZAČALA OBJEVOVAT RŮZNÁ PRUŽNÁ TĚSNĚNÍ, JEŽ MĚLA PROBLÉM ELIMINOVAT.

Author Autor: Alexander Kuric

grooves in the wooden beams, locking the window closed at the same time (the side jambs held identical but fixed bars). However, as discussed below, this solution proved to be less than ideal, and draughtiness turned out to be one of the design's main weak points. Nonetheless, from today's perspective, the wooden infills helped to alleviate the thermal bridge of the steel frame, though as can be clearly seen on thermal images, the frame still serves as a path for excessive heat loss. We can only speculate if this advantage was intentional, because while the poorer thermal performance of steel windows was known at the time, none of the propagation materials for the Kraus window mention this aspect. Interestingly, some years later, this same benefit of combining steel window frames with wood was mentioned in the 1940 volume of the journal *Architektura*, though not in the context of mentioning Kraus's windows.¹⁰

Several additional issues arose from the window's unique design arrangement. Neither the construction details nor the manufacturing process were simple, and in addition to various components (such as fittings) that had to be bought by the manufacturer from other companies, each window unit required up



THERMAL IMAGE OF THE KRAUS WINDOW (RIGHT) COMPARED TO ITS PRESENT-DAY REPLACEMENT (LEFT). THE STARK DIFFERENCES ARE CLEARLY VISIBLE BETWEEN THE DEGREES OF HEAT LOSS THROUGH BOTH THE GLASS AND THE WINDOW FRAME. IN ADDITION, THE EFFECT OF INSULATION OF THE FACADE (LEFT) IS NOTABLE AS WELL.

TERMOVNÍMEK OKNA KRAUS (V PRAVO) VEDLE JEHO NOVODOBÉ NÁHRADY (V LEVO) JASNĚ UKAZUJE NESROVNATELNĚ VĚTŠÍ ÚNIKY TEPLA RÁMEM I ZASKLENÍM. ZÁROVEŇ JE NA SNÍMKU PATRNÝ EFEKT ZATEPLENÍ FASÁDY.

Author Autor: Alexander Kuric



ADVERTISING BROCHURE FOR THE KRAUS WINDOW BY THE ROSICE MINING COMPANY

REKLAMNÍ BROŽURA OKNA KRAUS OD ROSICKÉ BĀŇSKÉ SPOLEČNOSTI

Source Zdroj: Překlápěcí ocelová okna Kraus. Brno, Rosice Mining Company. Carton 63, No. 83. Moravian Provincial Archive

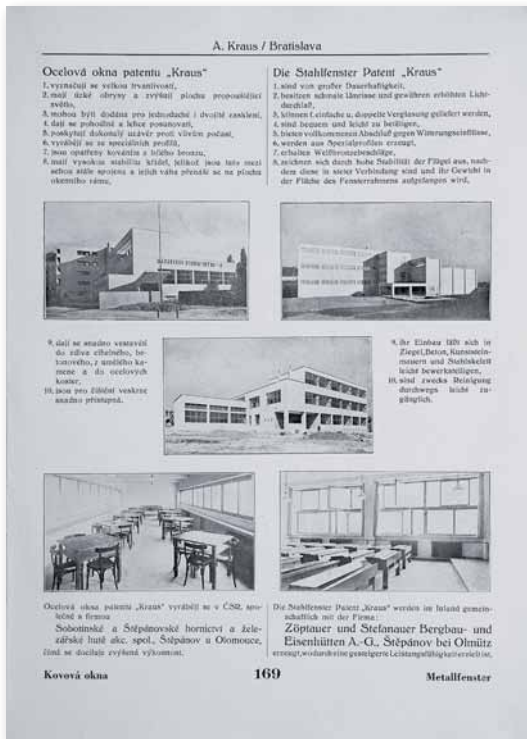
to 12 different types of steel profiles, most of which were initially not even produced in Czechoslovakia and had to be imported from Germany.¹¹ The frame resulting from the use of these profiles was also quite heavy, with a window of a size 2x1,75 meters weighing approximately 140 kg.¹² Discussions can be found in the archives of the Rosice Mining Company (RMC), one of Kraus's Czech license-holding manufacturing partners, claiming that replacing the profiles with lighter, domestically manufactured Jäkel steel profiles would reduce the weight up to 16% and the resulting price up to 7%, without negatively affecting any other properties.¹³ Indeed, the high price was another issue of the Kraus window, with not only the weight and complexity of the design but also the chosen materials – steel, oak and white bronze for the fittings – adding to it significantly. As such, the window was a far cry from an economical and affordable design, representing instead a sophisticated, but costly high-end product for demanding customers.¹⁴ This financial aspect greatly contributed to the struggles that followed during the subsequent years of the window's history: although it did enjoy early success,¹⁵ with the advancing effects of the Great Depression the innovative yet complicated design increasingly proved to be an obstacle.

Kraus in Advertising: The Modernist Window Vision

Initially, the Kraus window was received favorably by the Modernist architectural avantgarde. As Henrieta Moravčiková points out, Karel Teige was among the window's most high-profile propagators, mentioning them specifically among other types in the context of an exhibition of sliding windows organized by CIRPAC for the 1930 Brussels CIAM congress, where examples of the Kraus window were shown. Though it is not entirely

clear if the events indeed took place the way Teige describes them,¹⁶ some insights can be gathered from his report regarding the window's design and the reasons it closely matched the technical visions of the avantgarde. The focus of the 1930 CIAM congress was the minimal dwelling. In this context, sliding windows were a topic of particular interest, and were regarded as an important component in the search for maximal spatial economy where every square centimeter had to be counted - thus showing regular windows, with their opened casements taking up room space, not to be an optimal solution.¹⁷ However, in regular sliding window models, poor draught-proofing was considered a problematic issue.¹⁸ Here, Kraus's unique construction solution offered the space-saving benefits of sliding windows, yet thanks to the wooden infills and elimination of the sliding mechanism with its notorious draughtiness, ostensibly with none of their drawbacks. This was probably one of the chief reasons why Karel Teige wrote that Kraus's window "attracted a significant amount of attention" and that it was received positively, not the least because of - curiously - its seemingly favorable price.¹⁹

Kraus promoted the window actively, quickly capitalizing on Teige's praise from CIAM,²⁰ though other examples were also used. Two chief themes can be distinguished in these advertisements, pertaining on one hand to ideas of technical quality and comfort of use, and on the other, hygienism,



A KRAUS ADVERTISEMENT IN THE 1931 CATALOGUE OF THE CONSTRUCTION INDUSTRY. DURING THIS TIME, THE WINDOWS WERE ALSO MANUFACTURED BY THE SOBOTÍN IRONWORKS, WHICH ARE REFERENCED IN THE AD.

REKLAMA NA OKNO KRAUS V KATALOGU STAVEBNÍHO PRŮMYSLU Z ROKU 1931. REKLAMA ODKAZUJE NA SOBOTÍNSKÉ ŽELEZÁRNY, JEŽ V TÉTO DOBĚ OKNO LICENČNĚ VYRÁBĚLY.

Source Zdroj: Katalog stavebního průmyslu. 1931. Český Těšín, p. 169

embodied by efficient ventilation and maximum penetration of daylight. Two advertisements appeared in the Czech modernist architectural revue *Stavitel*, both of which praised the window's sleek frame, allowing maximum light to enter the room, as well as good draughtproofing, low cost and precise, reliable construction quality stemming from the mechanized production method.²¹ The window was also showcased in the 1931 *Catalogue of the Construction Industry*, a Czechoslovak attempt to present customers with an overview of the construction and architectural innovations available on the market, in the spirit of the catalogues available in the USA. Along similar lines with the previous marketing examples, this ad praised the window's good draught proofing, quality of manufacture, ease of use and longevity.²² Similar wording was also used on ad brochures printed by the Rosice Mining Company.²³ Finally, the culmination of the Kraus window marketing campaign was reached when examples were physically exhibited to the public: first in 1930, when they were part of the annual Prague Spring fair, gaining positive attention,²⁴ and later in 1933, when several examples were physically showcased at the Exhibition of Construction and Housing in Brno. As has been pointed out,²⁵ several prominent architects took a liking to Kraus' window; apart from the already mentioned Fridrich Weinwurm, another architect to use them frequently in his projects was the Brno-based Bohuslav Fuchs.



KRAUS WINDOWS DISPLAYED AT THE EXHIBITION OF CONSTRUCTION AND HOUSING IN BRNO, 1933

OKNA KRAUS NA BRNĚNSKÉ VÝSTAVĚ STAVEBNICTVÍ A BYDLENÍ V ROCE 1933

Source Zdroj: Architekt SIA, 1933, 32, p. 183

Kraus: A Troublesome Commercial Product

But despite the window answering the visionary calls of the Modernist avantgarde, its reaction from the general public registered considerably less excitement. The main cause, despite Teige's praise, was its high price. The Rosice Mining Company did not have fixed prices and instead set the price of each window individually, according to its dimensions and the number of sashes.²⁶ Archived transaction records put the price of a single Kraus window measuring 120x200 cm at 1315 Kč, approximately 550 Kč/m².²⁷ Another record shows 4 windows with a combined size of 16,8 m² being sold for 8800 Kč, which would equal approximately 524 Kč/m².²⁸ The price of a standard wooden double side-hung window equal in size to the first example was around 600 Kč, or 250 Kč per square meter²⁹ – meaning that Kraus' windows were more than two times as expensive as the commonly used window types. Considering their rather complicated design solution, the high price seems understandable – one would expect to pay a premium price for premium quality. However, with the Kraus windows, the tradeoff was not so clear. Complaints were appearing that targeted not only their high price, but also their unsatisfactory performance. Reportedly, the windows were drafty,³⁰ with some going as far as stating that they were “widely rejected” because of it,³¹ and suffered from problems with water infiltration through the bottom of the frame.³² In light of these problems, some customers demanded refunds, which forced the

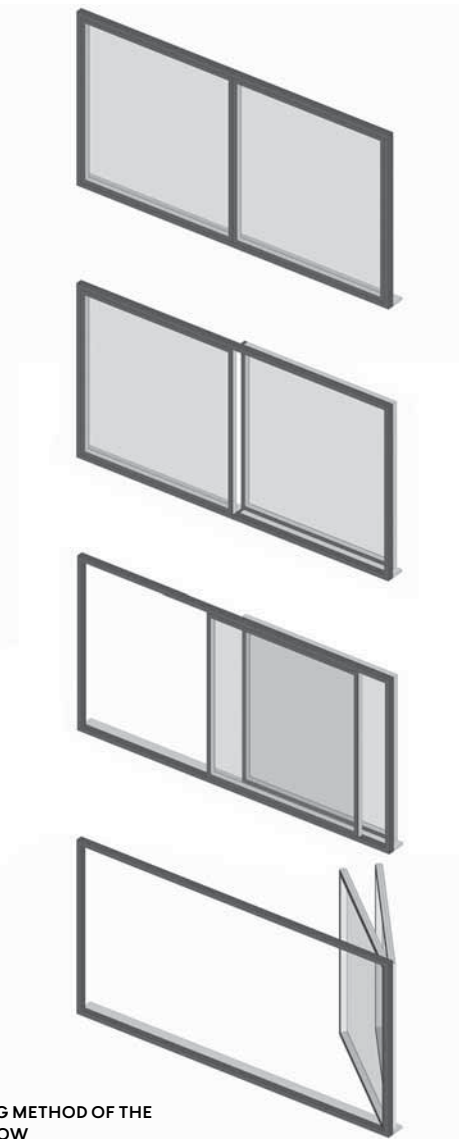
RMC to spend “tremendous sums” on having the faulty windows repaired.³³ Kraus insisted that these issues stemmed from the manufacturing process used by the RMC, and not from his design.³⁴ Nonetheless, the windows continued to exhibit issues, and the Czech manufacturers, both the RMC and later the Podhajský company, attempted to address the air infiltration by adding additional draught-proofing seals made from flexible lead or asbestos strips into the grooves of the wooden infills.³⁵

This combination of high price with unreliable performance meant that the windows could have hardly garnered an enthusiastic response, especially in light of the continuing Depression, and their sales were dropping by the year. In 1932, RMC received 46 orders for the window, but in 1933 this number fell to 26, a year later 14 and finally in 1935 only 3.³⁶ This development strained the relationship between Kraus and the company; several years later, a RMC attorney would describe their partnership as “bothersome and economically harmful.”³⁷ His words seem to be validated by surviving RMC accounting records, according to which the window factory operated at a loss during every single year of its existence³⁸ until it was finally shut down in 1935.³⁹ Difficult times also hit Armin Kraus’s own factory, with approaching bankruptcy in 1932⁴⁰ and having to significantly downsize its workforce in the subsequent years, according to RMC reports.⁴¹

The Orbis Window

In one of his letters, Armin Kraus mentioned that the failure of the window was not only disheartening for economic reasons, but first and foremost for “moral and prestigious” ones.⁴² The problems of unreliability and high cost, stemming from the window’s complicated design, were such that he eventually decided to go back to the drawing board and create an entirely new window construction. Thus, Kraus’s second window invention, which he termed *Kraus-Orbis*, came into being. According to Kraus, he first started working on the new design sometime in early 1933.⁴³ It was registered at the patent office in October 1934, and the patent bearing the number 55 287 was formally assigned on 15. 1. 1936.⁴⁴

In contrast to the first design, the Orbis window was in many ways simplified and the previous opening mechanism was changed. The new design was in essence a two-sash sliding window which also allowed the user, once the sliding sash has been opened, to swing both sashes together inwards on side-hung hinges, as in casement windows. Compared to the first design, it meant an improvement, because not only could the window frame still be mostly opened without taking up interior space, but additionally, opening the sashes on hinges allowed the user to fully connect the room with the exterior, a feature not present in the first design. Both sashes, double-glazed with 3 mm thick glass panes,⁴⁵ could also be opened full to allow for cleaning from all sides, just as in the first window. An additional key feature of the Orbis window was that, in contrast to regular sliding windows, both sashes were positioned in the same plane of the frame, meaning that for one of them to slide, the other had to move out of the way first. This was done by a special mechanism which moved one of the sashes slightly inwards, perpendicular to the plane of the window, forming a slight



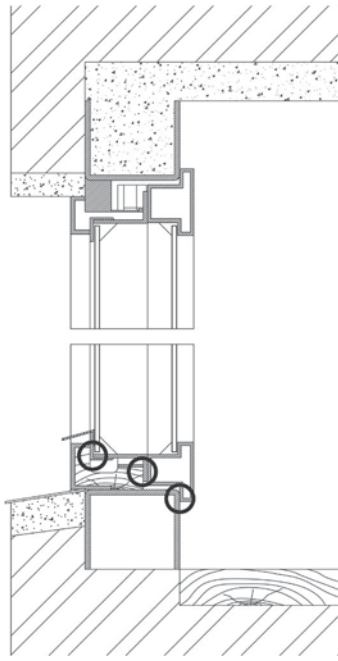
THE OPENING METHOD OF THE ORBIS WINDOW

ZPŮSOB OTVÍRÁNÍ OKNA ORBIS

Author Autor: Alexander Kuric

opening that could also be used for easy ventilation. Although the process of opening the window, now controlled from two distinct points as opposed to just one in the first window would thus appear more complicated than ads for the Kraus window, remained on ease of manipulation. The design choice of using a single plane was marketed in terms of economy and architectural quality, allowing the window frame to have sleeker and more attractive dimensions.⁴⁶ Aiding in this aspect was the elimination of grooves from the frame; instead, the sash slid using a moving pulley hidden in the frame’s top jamb.

Regarding materials, the distinctive combination of a steel frame with wooden beams was retained, but in a different setup. Instead of the oak beams being mounted onto the sash on all sides as before, on the Orbis they are a fixed part of the window frame, with the exception of the top jamb which instead held the pulley. With this change, the steel bars that were used for locking the window in the closed position in the first design also



VERTICAL CROSS-SECTION OF THE ORBIS WINDOW. IN COMPARISON TO THE FIRST KRAUS WINDOW, THE FRAME APPEARS MORE LIGHTWEIGHT, WITH FEWER (AND SLEEKER) STEEL PROFILES USED. IN TERMS OF DRAUGHTPROOFING, THE SASHES NOW HAVE 3 SEALING AREAS OF CONTACT (MARKED BY CIRCLES), AS OPPOSED TO JUST ONE FOR THE FIRST DESIGN. IN THE TOP JAMB OF THE FRAME, THE WOODEN INFILL IS MISSING, LEAVING ROOM FOR THE MOVABLE PULLEY MECHANISM.

SVISLÝ ŘEZ OKNEM ORBIS. VE SROVNÁNÍ S PRVNÍM OKNEM JE RÁM SESTAVEN Z MENŠÍHO POČTU ŠTÍHLEJŠÍCH PROFILŮ. TĚSNICÍ KONTAKT KŘÍDLA A RÁMU JE ZDE VE TŘECH ÚROVNÍCH (OZNAČENY KROUŽKEM) OPROTI POUZE JEDINÉ U OKNA KRAUS. V HORNÍM PROFILU RÁMU JE MÍSTO DŘEVĚNÉ VLOŽKY JEZDEC POSUVNÉHO MECHANISMU OKNA.

Author Autor: Alexander Kuric

disappeared. Instead, the window was locked in position by the mechanism that moved one of the sashes inwards, while the second sash was firmly held in position by the first one.

It is likely that through this alteration, Kraus sought to simplify the design and address the issues of draughtiness which proved problematic in the first one, as discussed before. The new solution created 3 sealing points of contact between the sash and the frame instead of just 1 in the old design, though the downside was that in some parts, two metal surfaces now touched, which the first window took great lengths to avoid. Kraus attempted to remedy this weakness by fitting the window with flexible strips of bronze that would serve as additional reinforcement in terms of draught proofing,⁴⁷ reflecting perhaps the adaptations that Czech manufacturers made to the first Kraus window. In this context, it comes as a surprise to read Kraus' alleged remark during one of his meetings with the manufacturers that it "won't hurt at all" if the draught proofing were not

installed on the top side of the window, because it would then allow it to "ventilate better".⁴⁸ This stance could perhaps be read as a certain lax attitude on part of Kraus towards the technical issue, but given the effort he had demonstrated towards resolving it, he could have been approaching it from a hygienist viewpoint, which in the Modernist discourse at times tended to overshadow other questions.

Due to the sliding opening solution, the Orbis window could no longer be offered in a horizontal variant, thus only a single version of the mechanism existed. The maximum size of a single unit was 2x2 meters, though – again unlike the first Kraus window - there were no mentions of possible arrangements of multiple windows into a larger setup. In terms of manufacturing specifics, it seems that Kraus managed to reduce the number of different types of rolled steel profiles required, as well as eliminating the necessity of imported types, contributing to a lower production cost. Still, it would appear it was difficult for Kraus to abandon his penchant for perfectionist and at times overengineered or expensive solutions – there is a record, for example, of his insistence for using a more expensive lever as an opening handle as opposed to a simple common handgrip, or his suggestion that both the lever and even the entire window should be offered in a stainless-clad option.⁴⁹ When Kraus presented an upgraded prototype of the window after initial discussions before the manufacturing began, his business partners lamented that all of the improvements he made meant "more or less additional expenses".⁵⁰

Orbis: A Positive Reception?

Because of his license agreement with the Rosice Mining Company, Kraus transferred to it the manufacturing of the Orbis window to this company.⁵¹ However, he was able to bargain that in Slovakia, he would produce and sell the windows himself, and only give RMC a small percentage share of the sales revenue, up to a total amount. This amount was set at 400 000 Kč, which hints at the high success both parties expected for the new window.⁵² And indeed, these expectations seemed to be strengthened by the first feedback the window received. Just as with the first Kraus design, the Orbis window itself enjoyed a positive reception from the architectural audience. A meeting was arranged for the window to be presented to the architect Bohuslav Fuchs and a representative of another esteemed Brno-based architect, Ernst Wiesner. Both seemed to appreciate the design, noting its "simplicity and practicality".⁵³ In 1934, even before the new window was submitted for patenting, Kraus already claimed he had received several orders for it.⁵⁴

Unfortunately, this optimism was not to last long. The selling price for Orbis was set around 340 Kč per square meter⁵⁵ – although considerably less than the first window, it was still almost 40% higher than the prices of regular wooden windows. A particularly interesting source in this context is the report of Josef Suchý, a traveling salesman of the Rosice company, who in 1935 was tasked with visiting several towns and cities in Czechoslovakia to advertise the new window. After visiting around 30 potential buyers, he failed to receive a single order, apart from three vague promises of future interest. He writes that interest

always seemed high at first, but only until the price was mentioned, after which it always “cooled down significantly”. One of the unpersuaded customers responded that he had already complained to the company before because of the “outrageous” price of the window, and that he would not “waste three and a half thousand just for two holes in a wall”.⁵⁶ Another suggested that the company should instead “invent metal windows that would be cheaper than wooden ones.”⁵⁷ Apart from the price, another issue that complicated the marketing campaign was the already existing high competition. The report mentions six other companies offering their own designs of metal windows, furthermore all of them priced cheaper than either of the Kraus windows.⁵⁸ All of this of course was occurring on the background of the still ongoing Depression. Thus, Suchý’s journey must have been rather disheartening for both RMC and Kraus. As another of the unconvinced customers noted, the Orbis window “arrived 5 years too late”. In 1929 there was demand for technical novelties, but “today, builders give away windows for free in exchange for the opportunity to build anything at all.” Suchý concludes his report bleakly: “[Orbis] Is not a child of its time. Either it should have been born in 1929 (...) or its time is yet to come.”⁵⁹

Orbis: An Unfulfilled Potential

In the late 1930s, the effects of the Depression began to wane, and even a higher-end product such as the Orbis could hope again to find success. This hope was strengthened by the fact that even the first Kraus window, manufactured since 1937 under license by the Prague-based company Podhajský,⁶⁰ began to see optimistically rising sales once more.⁶¹ Unfortunately, one more unlucky development took place that prevented Kraus’ new creation from gaining the desired commercial success. In July 1937, Kraus reported that the newly finished building of the Moldavia-Generali insurance company in Prague⁶² was equipped with windows that infringed his patent for the Orbis window.⁶³ These new windows’ market name was *Cristal*, and their design was indeed in many ways almost identical to Kraus’. As it later turned out, a window with similar key features to Orbis had been patented in Austria and Switzerland before Kraus’ patent, which made the exclusivity of his subject to legal challenges.⁶⁴ Because of this, the *Cristal* window could be sold freely, and in fact it seemed to have completely overshadowed the Orbis window: in Czech architectural journals of the late 1930s and 40s, one can find multiple advertisements and mentions of *Cristal*,⁶⁵ and the *Cristal* window even appeared in the 1940 Prague exhibition “For a new architecture,”⁶⁶ while the Orbis window had no mentions whatsoever. The *Cristal* advertisements praised almost exactly the same qualities that were highlighted in Kraus’ invention, such as the unique sliding system, good draughtproofing and slender frame dimensions, only emphasizing the thermal and energy-saving qualities more strongly than the advertisements of Kraus.⁶⁷ It was also likely the *Cristal* window which was referenced in an 1940 article about the good thermal properties of combined wooden-steel window frames mentioned earlier.⁶⁸

Because of the pause in manufacturing due to the closure of the RMC’s window factory in 1935 and the issue of the patent,



ADVERTISING BROCHURE FOR THE ORBIS WINDOW BY THE ROSICE MINING COMPANY

REKLAMNÍ BROŽURA OKNA ORBIS OD ROSICKÉ BÁŇSKÉ SPOLEČNOSTI

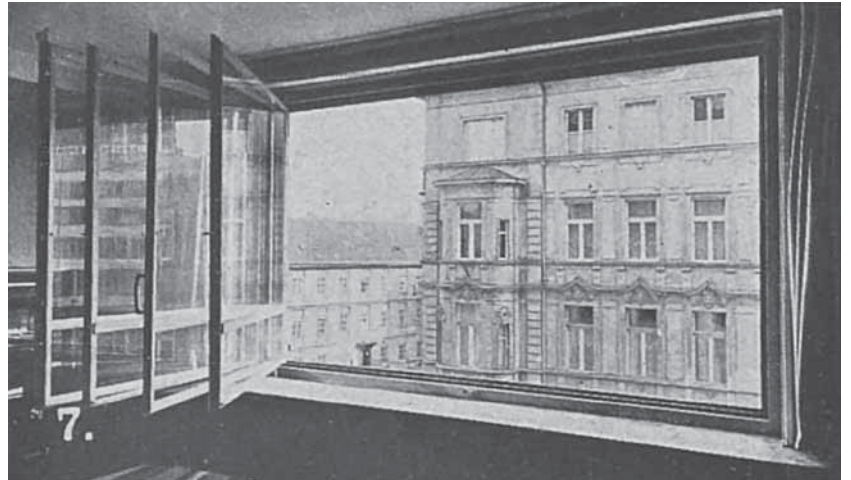
Source Zdroj: Posuvné ocelové okno “Kraus-Orbis”. Brno, Rosice Mining Company. Carton 63, No. 83. Moravian Provincial Archive

very few Orbis windows were produced in the Czech part of the state. The accounting reports of RMC only mention the sale of 8 examples for a villa in Brno,⁶⁹ and the Podhajský company was discouraged by the patent conflict, so much so that to prevent legal complications, it gave up its manufacturing license for Orbis in 1938.⁷⁰ Before Kraus could resolve this conflict, political developments of 1938 – 1939 forced him out of the country. Thus the majority of the Orbis windows produced seem to have been manufactured directly in Kraus’s factory in Bratislava, where he reported a turnover in their sales of roughly 830 000 Kč between 1934 – 1938.⁷¹ This figure was not an insignificant amount, considering, for example, that the Rosice company achieved a turnover of 2.2 million Kč for the first Kraus window during its entire three-year license-holding period,⁷² but still considerably less in comparison – especially given that the first Kraus window was also manufactured by several other companies during its market life.⁷³ Because the detailed accounting records of the Kraus company have been lost, it is difficult to locate the specific buildings where they were used. The windows were installed in the Farmer’s Cooperative buildings in Bratislava, designed by Emil Belluš and built between 1934 – 1939; here, their presence

THE CRISTAL WINDOW. ITS OPENING METHOD, AS WELL AS MANY DETAILS, WERE ALMOST IDENTICAL TO THOSE OF ORBIS.

OKNO CRISTAL. ZPŮSOB OTVÍRÁNÍ A ŘADA DETAILŮ JSOU PRAKTICKY TOTOŽNÉ S OKNEM ORBIS.

Source Zdroj: Konstruktivní předpoklady nové architektury. 1940. Architektura, 1, p. 158



KRAUS WINDOWS ON AN APARTMENT HOUSE IN PRAGUE-DEJVICE, DESIGNED BY VLADIMÍR WEISS

OKNA KRAUS NA NÁJEMNÍM DOMĚ V PRAZE-DEJVICÍCH Z NÁVRHU VLADIMÍRA WEISSE

Photo Foto: Alexander Kuric

ORBIS WINDOWS ON THE BUILDING OF THE FARMERS' COOPERATIVES, BRATISLAVA, DESIGNED BY EMIL BELLUŠ

OKNA ORBIS NA BUDOVĚ DRUŽSTEVNÍCH DOMŮ Z NÁVRHU EMILA BELLUŠE

Source Zdroj: Archive of Matúš Dulla

can be confirmed by archival sources⁷⁴ as well as historical photographs, where their distinctive design can be seen. However, the building has since lost its original windows, being today equipped with contemporary replacements which are similar in appearance but differ in construction. Belluš also used the widows in the National bank building in Bratislava, opened in 1938, which now houses the General Prosecutor's Office. There, they remain to this day.

Belluš also very likely used them in the National Bank building in Bratislava, opened in 1938, which today houses the General Prosecutor's Office.

Conclusion

The Kraus window was an invention with contradictory results. On one hand, it deserves credit for its unique, progressive design responding to the calls of avantgarde architects for a modern window type that would suit the needs of the new era, and successfully winning their favor with it. On the other hand, it can also be viewed as an overly ambitious product marked by technical flaws arising from its complicated design and demanding a steep price. In particular, it was the question of poor draughtproofing that proved a key issue in the design, forcing manufacturers to come up with improvised fixes and partial



KRAUS WINDOWS ON AN APARTMENT HOUSE IN PRAGUE-NEW TOWN, DESIGNED BY FERDINAND FENCL

OKNA KRAUS NA NÁJEMNÍM DOMĚ NA NOVÉM MĚSTĚ VE SPÁLENÉ ULICI Z NÁVRHU FERDINANDA FENCLA

Photo Foto: Alexander Kuric

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ING. ARCH. ALEXANDER KURIC

ÚSTAV TEORIE A DĚJIN ARCHITEKTURY
FAKULTA ARCHITEKTURY ČVUT

Thákurova 9, Praha 6
Czech republic
alexander.kuric@fa.cvut.cz

solutions. Kraus' second attempt at a modern window construction, the Orbis, serves as a testament to his ability to recognize the flaws of the previous design and respond to them, as well as his determination to bring his creation to success. The second design successfully eliminated the key issues and managed a greater degree of economy, though even then remaining unable to achieve the status of an affordable product for the masses. In the end, through a series of unlucky developments, the Orbis window could never win the success it perhaps otherwise might have, and never reached the prominence of the first window.

In a way, the troubles of the Kraus windows are representative of many innovations of the early Modernist era. It was a time of experimental searching, attempting to fulfill newly arisen and recognized needs through modern and often unproven forms. Not all of them could pass the test of practical use, and some of them remained only as short-lived experiments.⁷⁵ To some degree, this judgment can be applied to the first Kraus window, which a mere five years after its conception was already redesigned by its creator from scratch. But despite all shortcomings, it is also necessary to recognize that the window did possess its qualities, proven after all by the fact that even today, some 80 years later, original examples still remain in use in several buildings.⁷⁶ The Orbis window, with its success hindered perhaps more by external events than the fault of the design itself, shows another side of such an era of technological growth, where not solely the technical aspect decides which solution will thrive, and which will remain only a short chapter in history.

1 ŽÁČEK, Milan and VÁCHA, Zdeněk. 2016. *Kov, sklo a povrchové úpravy těchto materiálů v meziválečné architektuře*. Brno: NPÚ, pp. 23 – 25; NATIONAL HERITAGE INSTITUTE. 2018. *Masarykův studentský domov – repase oken* [online]. Available at: <https://www.npu.cz/cs/uop-brno/pro-media/40330-masarykuv-studentsky-domov-repase-oken> (Accessed: 28 December 2020).

2 MORAVČÍKOVÁ, Henrieta, 2022. Krausz patented steel-framed Windows: from remarkable phenomenon to huge obstacle. In: Jordá Such, C., Palomares Figueres, M., Tostoes, A. and Pottgiesser, U. (eds.). *Modern Design: Social Commitment & Quality of Life. Proceedings from the 17th International Docomomo Conference*. Valencia: Docomomo, pp. 854 – 862; MORAVČÍKOVÁ, Henrieta. 2014. *Friedrich Weinwurm architekt/ architect*. Bratislava: Slovart, p. 162; CHATRŇÝ, Jindřich and ČERNOUŠKOVÁ, Dagmar. 2019. *Vize Modernosti: Rudolf Sandalo*. Brno: Muzeum města Brna, p. 56.

3 Moravčíková, H., 2022, p. 856.

4 Moravčíková, H., 2022, p. 856.

5 *Překlápěcí ocelová okna patentu Krausova*. 1937. Praha, Ing. O. Podhajský, Rosice Mining Company, carton 64, no. 84. Moravian Provincial Archive.

6 *Ibid; Překlápěcí ocelová okna Kraus*. Typo Rossmann, Brno, Rosice Mining Company, Zastávka u Brna, carton 63, no. 83. Moravian Provincial Archive.

7 *Překlápěcí ocelová okna Kraus*. Typo Rossmann, Brno, Rosice Mining Company, Zastávka u Brna, carton 63, no. 83. Moravian Provincial Archive.

8 *Patentní věstník*, 1931, 13, p. 305, 410, 450.

9 *Překlápěcí ocelová okna Kraus*; Typo Rossmann, Brno, Rosice Mining Company, Zastávka u Brna, carton 63, no. 83. Moravian Provincial Archive. *Překlápěcí ocelová okna patentu Krausova*. 1937. Praha, Ing. O. Podhajský, Rosice Mining Company, carton 64, no. 84. Moravian Provincial Archive.

10 PATERA, Jiří. 1940. Okno dneška a zítřka. *Architektura*, 2, unmarked advertising page.

11 16. 2. 1932. Rosice Mining Company, 63/83. Moravian Provincial Archive.

12 13. 5. 1932, Rosice Mining Company 63/83. Moravian Provincial Archive.

13 3. 9. 1932, Rosice Mining Company 63/83. Moravian Provincial Archive.

14 This aspect is even mentioned in the RMC advertisement for the win-

- dow, where buyers are reminded to take into account the quality of used materials when comparing prices with the competition. See *Překlápěcí ocelová okna Kraus*. Typo Rossman, Brno, Rosice Mining Company, Zastávka u Brna, carton 63, no. 83. Moravian Provincial Archive.
- 15** Moravčíková, H., 2022, pp. 857 – 858. It is, however, worth noting that the windows were mostly found on schools, banks, insurance headquarters and villas, i.e. buildings where the budget would permit their higher price.
- 16** Moravčíková, H., 2022, pp. 857 – 858.
- 17** HEIM, Richard. 1931. Posuvná okna. *Stavební rádce*, 4, pp. 233 – 234.
- 18** TEIGE, Karel. 1931. 3. mezinárodní kongres moderní architektury v Bruselu. *Stavba*, 11, pp. 112 – 113.
- 19** Ibid. However, considering the later struggles of the window as a commercial product, it would seem that Teige either lacked accurate information regarding the price, or was perhaps trying to intentionally paint the windows in a better light.
- 20** Moravčíková, H., 2014, p. 162.
- 21** Ocelová okna patent “Kraus”. 1930. *Stavitel*, 11, p. 15; Ocelová okna patentu Krausova. 1932. *Stavitel*, 13, p. 44.
- 22** *Katalog stavebního průmyslu*. 1931. Český Těšín, pp. 168 – 170. Like the entire catalogue, the Kraus company advertisement was both in Czech and German. Apart from the window, Kraus’s company also marketed its metal door frames in the same publication.
- 23** *Překlápěcí ocelová okna Kraus*. Typo Rossman, Brno, Rosice Mining Company, Zastávka u Brna, carton 63, no. 83. Moravian Provincial Archive.
- 24** Jarní pražský vzorkový veletrh. 1930. *Staviteleské listy*, 26, p. 124.
- 25** Moravčíková, H., 2022, p. 856.
- 26** Rosice Mining Company, 64/84, p. 86. Moravian Provincial Archive.
- 27** 3. 9. 1932. Rosice Mining Company, 63/83. Moravian Provincial Archive.
- 28** 17. 12. 1931. Rosice Mining Company, 63/83. Moravian Provincial Archive.
- 29** Rosice Mining Company, 64/84, p. 86. Moravian Provincial Archive.
- 30** Rosice Mining Company, carton 62, no. 82, pp. 78 – 79. Moravian Provincial Archive.
- 31** Rosice Mining Company, 62/82, pp. 78 – 79. Moravian Provincial Archive.
- However, the person making this claim was acting on behalf of the Hermetol company, which manufactured draughtproofing strips, trying to convince the RMC to buy its product, so the claim undoubtedly had a bias to it.
- 32** Rosice Mining Company, 62/82, pp. 276 – 277. Moravian Provincial Archive.
- 33** Rosice Mining Company, 62/82, pp. 226 – 227. Moravian Provincial Archive.
- 34** Rosice Mining Company, 62/82, pp. 270 – 273. Moravian Provincial Archive.
- 35** 14. 10. 1936, Rosice Mining Company, 64/84 Moravian Provincial Archive.; *Překlápěcí ocelová okna patentu Krausova*, 1937. Praha, Ing. O. Podhajský, Rosice Mining Company, carton 64, no. 84. Moravian Provincial Archive.
- 36** Rosice Mining Company, 64/84, pp. 7 – 11. Moravian Provincial Archive.
- 37** Rosice Mining Company, 64/84, pp. 76. Moravian Provincial Archive.
- 38** This source even provides us with the information about the level of financial losses suffered. In 1932 the loss amounted to 116,000 Kč, in 1933 and 1934 about 330,000 Kč each year and in 1935 approximately 260,000 Kč. Moravian Provincial Archive. Rosice Mining Company, Book 59 and 60.
- 39** 12. 5. 1937. Rosice Mining Company, Carton 64, No. 86. Moravian Provincial Archive.
- 40** Rosice Mining Company, 62/82, pp. 8, 35 – 36, 368. Moravian Provincial Archive.
- 41** Rosice Mining Company, 62/82, pp. 16 – 17. Moravian Provincial Archive.
- 42** Rosice Mining Company, 62/82, pp. 270 – 273. Moravian Provincial Archive.
- 43** Rosice Mining Company, 62/82, pp. 270 – 273. Moravian Provincial Archive.
- 44** *Patentní věštník*, 1936, 18(7), p. 468.
- 45** The ad proudly states that the distance between the glass panes is 6,5 cm, the figure considered best by heating engineers. However, this was not entirely true; the ideal distance was understood to be even smaller, about 4 cm. See KRCH, Vojtěch. 1934. Okno. Studie a rozbor účelů, nevhodnější tvary a řešení. *Architekt SIA*, 33, pp. 144 – 152, 161 – 168, 177 – 184, 193 – 200.
- 46** *Posuvné ocelové okno “Kraus-Orbis”*. Rosice Mining Company, Zastávka u Brna Ironworks. My grateful thanks to Jakub Potůček for providing this source.
- 47** Rosice Mining Company, 63/83, pp. 94 – 97. Moravian Provincial Archive.
- 48** Rosice Mining Company, 63/83, pp. 94 – 97. Moravian Provincial Archive.
- 49** Rosice Mining Company, 63/83, pp. 94 – 97. Moravian Provincial Archive.
- 50** Rosice Mining Company, 62/82, p. 65. Moravian Provincial Archive.
- 51** Rosice Mining Company, 62/82, pp. 397 – 401. Moravian Provincial Archive.
- 52** Rosice Mining Company, 63/83, pp. 103 – 106. Moravian Provincial Archive.
- 53** Rosice Mining Company, 62/82, pp. 258 – 260.
- 54** Rosice Mining Company, 62/82, pp. 265 – 268.
- 55** Rosice Mining Company, 62/82, pp. 66 – 70. Moravian Provincial Archive.
- 56** Rosice Mining Company, 62/82, pp. 66 – 70. Moravian Provincial Archive. Moravian Provincial Archive.
- 57** Rosice Mining Company, 62/82, pp. 66 – 70.
- 58** The companies are: Podhajský, Okenia, Ippen, Doležal-Těhník, Pleva, Beer. Of particular interest are the Doležal-Těhník and Pleva windows, which according to Suchý were “a circumvention of the old Kraus patent, and perhaps more serviceable and cheaper”. Apart from these, the companies Mücke-Melder and Fr. Schenk are mentioned, yet they had earlier already ceased the production of steel windows. Rosice also produced a cheaper line of steel windows by the name of *Hermetik*.
- 59** Rosice Mining Company, 62/82, pp. 66 – 70. Moravian Provincial Archive.
- 60** 12. 5. 1937. Rosice Mining Company, 64/84. Moravian Provincial Archive.
- 61** Rosice Mining Company, 63/83, pp. 250 – 251. Moravian Provincial Archive.
- 62** The specific building is the one on Prague’s Národní třída designed by B. Kozák and A. Černý. See KOZÁK, Bohumír and ČERNÝ, Antonín. 1937 – 1938. Dům pojišťoven Assicurazioni Generali a Moldavia-Generali v Praze. *Stavba*, 14, pp. 159 – 162, where such windows are mentioned.
- 63** Rosice Mining Company, 63/83, p. 361. Moravian Provincial Archive.
- 64** 27. 8. 1937. Rosice Mining Company, 64/86. Moravian Provincial Archive.
- 65** These ads appeared in the journal *Architektura*, vol. 1 and 2, and in the post-war journal *Stavebnictví* vol. 2 and 3.
- 66** Konstruktivní předpoklady nové architektury. 1940. *Architektura*, 1, p. 158.
- 67** Cristal-okno. *Architektura*, 1, unmarked advertising page.
- 68** Patera, J., 1940. The name of the window was never stated explicitly, but the article appeared in the same volume where Cristal was advertised.
- 69** Rosice Mining Company, 64/84, pp. 7 – 10. Moravian Provincial Archive.
- 70** Rosice Mining Company, 63/83, pp. 170 – 172. Moravian Provincial Archive.
- 71** Rosice Mining Company, 63/83, pp. 192-194. Moravian Provincial Archive. Soon after, dissolution of Czechoslovakia and the threat of war forced Kraus to emigrate to Palestine; the production of Orbis thus likely ended with his leaving. For details about Kraus’s life, see Moravčíková, H., 2022.
- 72** Ibid.
- 73** Apart from the Rosice Mining Company and Kraus’s own factory, it was also produced by the Sobotín Ironworks, which were then taken over by RMC, and finally by the Podhajský company in Prague.
- 74** Rosice Mining Company, 62/82, p. 185. Moravian Provincial Archive.
- 75** HARBOE, T. Gunny. 2000. Window Glass Technology in the 20th Century. In: De Jonge, W. and Wedebren, O. (eds.). *Reframing the Moderns: Substitute Windows and Glass*. Delft: Docomomo International, pp. 32 – 40, cited pp. 34 – 36.
- 76** Many of them are in Bohuslav Fuchs’s buildings in Brno, such as the Masaryk student dormitory, the Vesna Grils’ school or the elementary school in Černá pole. Others remain in residential buildings in Prague, such as on Spálená street (F. Fencl), in an apartment building in Dejvice (F. Weiss) or in a villa by J. Koula in the Baba estate. In Slovakia, they remain in one of the villas designed by F. Weinwurm and, perhaps most famously, though not truly ‘in use’ anymore, in the abandoned “Machnáč” sanatorium in Trenčianské Teplice. For more details, see Moravčíková, H., 2022.