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The Early Stages of the Standardization of Finnish Building Sector

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***Abstract*—**Early 20th century functionalism aimed at generalising living and rationalising construction, thus laying the foundation for the standardisation of construction components and products. From the 1930s onwards, all measurement and quality instructions for building products, different types of building components, descriptions of working methods complying with advisable building practises, planning, measurement and calculation guidelines, terminology, etc. were called standards. Standardisation was regarded as a necessary prerequisite for the mass production of housing.

This article examines the early stages of standardisation in Finland in the 1940s and 1950s, as reflected on the working history of an individual architect, Erkki Koiso-Kanttila (1914-2006). In 1950 Koiso-Kanttila was appointed the Head of Design of the Finnish Association of Architects' Building Standards Committee, a position which he held until 1958. His main responsibilities were the development of the RT Building Information File and compiling of the files.

***Keywords*—**Architecture, Post WWII period, Reconstruction, Standardisation.

I. Early Stages

THE aspiration to be involved in the rebuilding of Finland already began in the Finnish Association of Architects during the Winter War in 1939. By the initiative of architect Alvar Aalto, a reconstruction committee was established alongside the association in 1940, which then a few years later took up the development of standardisation as one of its main goals [1]. The Reconstruction Office of the Finnish Association of Architects was opened in the spring of 1942 with architect Viljo Revell as its managing director. The office had many other renowned Finnish architects as background influencers, such as Aarne Ervi and Yrjö Lindegren. One of the main functions of the office was to create the RT files. Standardisation gave initiative to the RT Building Information File, also intended to serve peace time building needs, and the foundation for the first RT File, a series of 70 standards, was drawn up in 1943. The quality standards of the new file were defined by Alvar Aalto, and they were to be up-to-date, easy to use, authoritative and comprehensive. The Building Standards Committee acted as part of the Reconstruction Office until the year 1946, when it was given a more independent role. It cooperated with KYMRO, the building standard committee appointed by the Ministry of Transport and Public Works' building department,[1] who made the final decisions regarding the standards [2].

The peace treaty with the Soviet Union, and the need to comply with the Soviet-dictated peace terms also affected the work of architects, as immigrants and those who had lost their homes during the war needed new housing. Architect Erkki Koiso-Kanttila had already become familiar with the Building Standards Committee towards the end of the war, particularly with the RT files. He knew well the central influencers of the Committee, architects Aarne Ervi and Viljo Revell[2] so the shift to working with standardisation came very naturally to Koiso-Kanttila. He started working as the committee's Design Architect at the end of 1944. His first project was to examine the standardisation possibilities of oven structures and cast iron stove plates. The task was no mean feat, as the prevailing module theory in the field of construction had not yet developed far enough, and the products of different manufacturers were only slightly different from one another. However, the work had progressed a great deal already when architect Ferdinand Salokangas, who then worked as the chief of the Lapland construction district, asked Koiso-Kanttila to join him in the rebuilding of Lapland in early 1945 [3]. The main task of the construction district was to manage the guidance, control and, in some respects, the execution of the residential and industrial building sites [4].

II. Lapland as the Testing Site for Standardisation

The creation of Northern Finland's reconstruction organisation had already begun in September 1944. The planning and implementation of construction projects and the creation of residential zones in rural areas were the responsibility of the Central Organisation of the Finnish Agricultural Societies (MKL), acting under the Ministry of Agriculture's housing department (ASO). Similar responsibilities regarding residential centres were in turn given to the Ministry of Transport and Public Works' temporary building department, referred to as KYMRO. In addition to

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[1] A *Standards committee* was established in connection with KYMRO in 1942. Its responsibilities included the official monitoring of the standardisation work, and it cooperated with the different associations and experts in the construction field, as well as the building product manufacturers. The committee commissioned the standard proposals from the Finnish Association of Architects' Building Standards Committee. KYMRO ordered the construction industry facilities to manufacture large quantities of homogenised building supplies, making it possible to use alternative products from different manufacturers that would all be compatible with the general standardised frame types. The Finnish Association of Architects did not find the reconstruction office to be efficient, and thus appointed a separate permanent standardisation board in 1947. The name Reconstruction Office was then changed to the Finnish Association of Architects' Building Standards Committee.

[2] Koiso-Kanttila had previously worked at Ervi's office, and Revell's wife was his wife's best friend, so they were family acquaintances.

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this role, it would also see to any issues relating to the construction of industrial facilities. The task of repopulating Lapland was a huge aggregate, and thus it was necessary to establish a separate construction district for Lapland under KYMRO [5]. The National Building Board acted as a third party in the reconstruction work, and it was responsible for the reconstruction of governmental buildings [6].



Fig. 1 Architect Erkki Koiso-Kanttila (1914-2006)

The type houses to be built in the rural areas and residential centres of Lapland were modelled on, for example, the model drawings published by the Ministry of Social Affairs' housing department and the Finnish Association of Architects' Reconstruction Office [7]. The Omakoti-series type houses Koiso-Kanttila designed for Lapland varied very little from other designs of the post war era period houses. Structurally these houses relied firmly on the Finnish tradition of timber building, but like other type houses of this period, they varied in appearance from the traditional Finnish houses. The one and a half storey buildings with lofts were high and had a dice-like shape, exaggerated by the somewhat steep saddle roof. The careful measurement of the type houses' floor plans, together with their design which was highly based on functionality, reflected the principles derived from the research on functionalism and minimalistic living space. Koiso-Kanttila compiled building instructions for the type houses he designed based on the RT files. Each building component had instructions detailing which RT file was to be followed in the construction. The RT files were clear and detailed with images and instructions, so even the builders with the least experience could build their own houses. In Finland, it was Lapland in particular where these RT files, and standardisation along with them, were used this widely and in such a systematic way in building [3]. Koiso-Kanttila saw the significance of planning assistance, not only for the purposes of reaching a certain level of technical quality, but also for bringing the work and professionalism of architects into the use of builders who would otherwise be very unlikely to use them [7].

Koiso-Kanttila knew Alvar Aalto well from their time together at the Building Standards Committee, and Aalto was aware of Koiso-Kanttila's efforts in the rebuilding of Lapland, and how he had efficiently utilised and promoted standardisation in his work. Thus, as the operations of the Building Standards Committee were being launched, Aalto telephoned Koiso-Kanttila and asked him to move to Helsinki in order to work as the head of the Finnish Association of Architects' Building Standards Committee's design department in 1950.[8] Architect Egil Nicklin had been appointed the head of the Committee earlier in the year [9].



Fig. 2 The destruction of WWII was heavy particularly in Northern Finland. As a result of the war some 40–47% of the dwellings in the area were destroyed, and the provincial capital of Rovaniemi was burned to the ground (SA-Kuva)

III. Challenges of Standardisation in the 1950s

All through the 1940s the Building Standards Committee had focused on giving instructions for builders in the form of RT files, which would speed up the building process and enable quality reconstruction, especially in terms of small residential houses. The time for standardisation had come about faster due to the war and the subsequent reconstruction than what peace time development might have otherwise allowed [10]. Koiso-Kanttila was put in charge of creating and publishing new RT files. He soon realised that in order for the Committee to be successful there would need to be sufficient sales of the RT files. Koiso-Kanttila described his new tasks in a letter to his wife: *"…I feel that my first job there will not, in fact, be standardisation, but rather fixing the financial issues of the Building Standards Committee, which too are an absolute mess and are in my opinion in need of complete reorganisation."*[11].

The Committee did not have an advertising or publicity department which would have increased the sales of the files. As a solution, Koiso-Kanttila started actively writing articles for magazines in the field, and organised Building Standards Committee events for architects. The latter became a great success. He would regularly write about the RT Files' current events in publications such as the Arkkitehtiuutiset magazine, and would show architect students around the RT Building Information File. Within a couple of years subscriptions for

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the RT File increased by a few thousand, which was also due to it being marketed to contractors [3]. The RT File was an inspiration in particular for the young architects, and it was, in fact, these young architects who made the use of the files popular. Experienced architects who had been in the industry for a long time would rather rely on their own experiences and settled for new variations of the details in their previous projects [12].

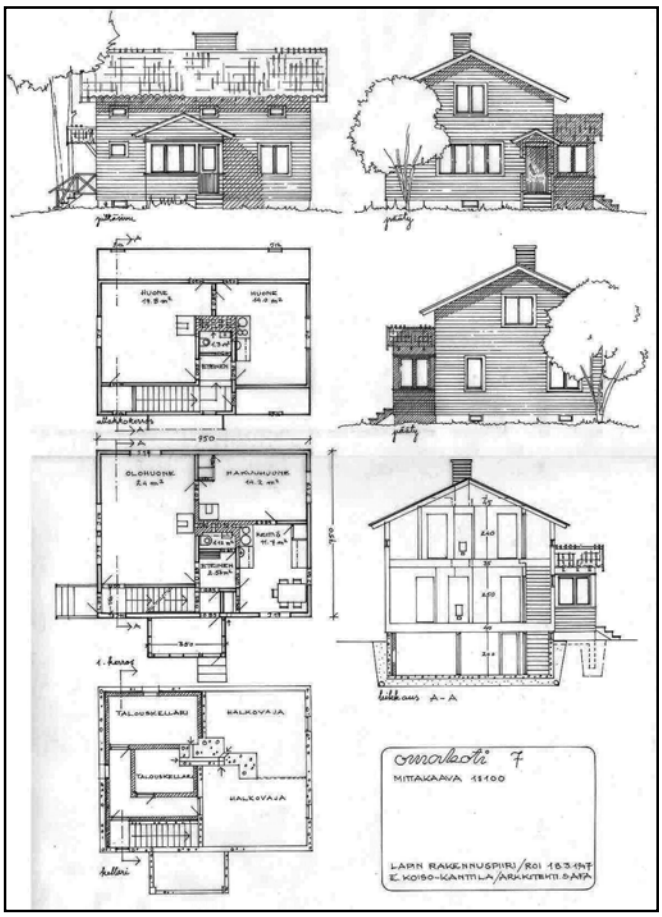


Fig. 3 Type house "Omakoti 7" designed by Erkki Koiso-Kanttila is quite typical example of reconstruction period small house

Koiso-Kanttila had a relatively everyday approach to standardisation; he found it necessary and thus practically self-evident. The head of the Committee, Egil Nicklin, did not work as a building designer at the time, so Koiso-Kanttila's connection with the everyday life of a designer was important [13]. He did not see his work as a completely new modern task, but rather as sort of a continuum. With his vision he also tried to clear away some of the fears and doubts related to standardisation: *"As an example that's more familiar to us one could mention the Finnish log house, which in many respects has been highly standardised both structurally and maintenance-wise, although there has never been a general Finnish log house standard per se. One might rather speak of regional standards, as different regions have slightly different methods of joining the logs. During the old log building era information on the common building methods and types among the builders were passed on from father to son, and as these methods stayed more or less the same from decade to decade, or even from century to century, it can, in my opinion, be justifiably argued that these building methods are naturally evolved building standards. As the building techniques evolved and requirements increased, the building methods became more and more complex, and as the need for building at the same time increased quite considerably, this 'from father to son' type of building knowledge became insufficient. Keeping of track with all the modern building techniques has become practically impossible for the individual building professional, as new articles and methods are being constantly brought to the market through development..."* [14].

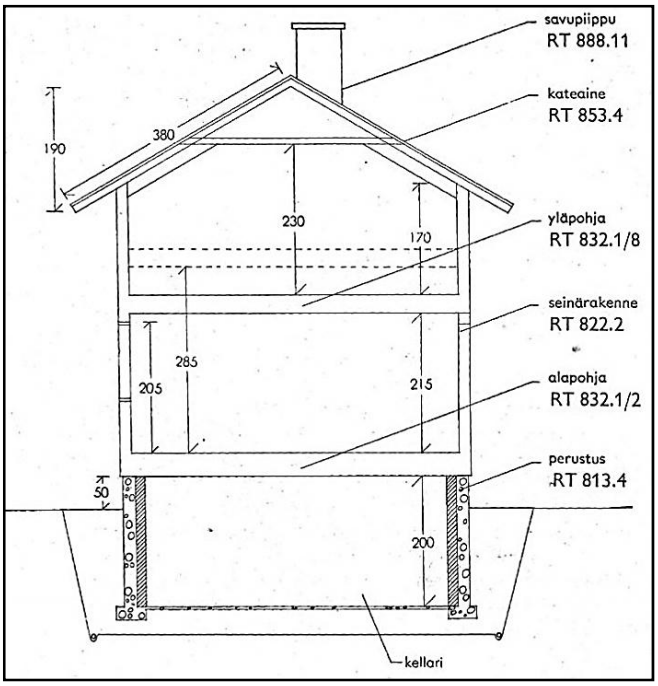


Fig. 4 The RT files were clear and detailed with images and instructions, so even the builders with the least experience could build their own houses. RT 888.11 refers to instruction card of chimneys, RT 853.4 to roofs, RT 832.1/8 and RT 832.1/2 to floors, RT 822.2 to wood frame wall structures and RT 813.4 to foundations. In those RT files simple and clear information is given how to construct that type of a structure

In Koiso-Kanttila's view, standardisation would be widely beneficial in the field of construction. With the use of the RT files, designers could spend less time and effort on the routine-like designing of details, and rather concentrate on solving the architectural problems. At the same time they would be able to trust the quality of the design details in the RT files and the scientifically proven information behind them. In terms of the actual building process, the RT files would clarify the methods in use and rule out the use of incorrect structures. The builder in turn would be able to use the files as guidelines, and as a building industry manual. Koiso-Kanttila considered the standardisation work to have great significance in terms of the national economy. The Nordic climate demanded that houses

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were to be built both sturdy and particularly warm, which further increased building costs. Research done in the field of building, as well as the standardisation work utilising the results of the research, would have a significant role in keeping those costs under control [14]. Koiso-Kanttila's related speeches and article drafts from the 1950s show his true passion for the work at hand.



Fig. 5 The personnel of Building Standards Committee was still limited in 1950's. Christmas' Party

IV. From Standardisation towards Education and Research

In most countries the standardisation of building began with manufactured supplies that were designed to meet a great demand, such as windows and doors, and then spread wider to include mostly products used in the construction of apartment buildings. In Finland the progress was different as the Building Standards Committee was initially a part of the Reconstruction Office that was founded in order to help rebuild Finland. This meant that the first targets for standardisation were the timber residential houses: type blueprints were designed at the same time as work was done in order to develop standard solutions for different building components. Thus, work essentially progressed along two lines, which later on were also made to include the development of standards for individual supplies. Progress was quite slow in the latter case, as Finland was still recovering from the war and suffered from an extensive lack of materials. The RT files served those who were building their own homes, but also those overseeing contractors and compiling work definitions and contracts. Experiences gained from the reconstruction period were later utilised, for example, in the type blueprint collection published in cooperation between Arava, the Association of Finnish Cities and the Finnish Association of Architects in the years 1951–1952 [15]. According to Nicklin, during the rapid development of the 1950s, research on construction components had a more important role than the actual standardisation work. During that time publishing of the RT files was first and foremost related to spreading the research results, rather than standards [13].

With the help of the RT files, residential house building during the reconstruction period had been carried under sufficient control and with good quality. Many advisable building practises were spread in the process. In the 1950s the emphasis of standardisation was more and more on the construction of apartment buildings, which was supported by the actions of the continuously developing construction product industry. A Permanent Building Products Exhibition had been set up in Helsinki in 1932, with the purpose of bringing the developments in the building industry into the consciousness of the Finnish public. Architect Kaj Englund had served as the exhibition's commissioner, followed by Aarne Ervi who then in 1953 persuaded Koiso-Kanttila to take his place in addition to his other work. The exhibition had reached a sort of standstill; it was difficult to grasp and had no system according to which the construction materials were displayed. Koiso-Kanttila decided to take the SfB classification system developed in cooperation with Sweden into use. According to the system the materials would be logically categorised, so that all materials used for the same purpose would be displayed together as a group, and groups would no longer be formed according to manufacturer [16]. Further exhibition space was created by building an additional balcony floor into the high-ceiling exhibition space, as well as a large luminous entrance hall with big display windows for new short term exhibitions [17]. During the evenings, film-strips were reflected onto the display window [3].

Koiso-Kanttila renewed the exhibition space, as well as the exhibition itself, quite thoroughly. By means of skilled exhibition design he was able to fit plenty of exhibition material into the space without creating a feeling of overcrowdedness. For example, the wall surfaces doubled as a paint exhibition, the floors as a floor covering exhibition and the balcony railing as a sheet glass exhibition. Material exhibitions additionally had information for instance about the costs, heat insulation and breathability of the materials, as well as other important information to be taken into consideration when choosing building materials [18].



Fig. 6 Erkki Koiso-Kanttila renewed the Permanent Building Products Exhibition using SfB classification system

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V. Nordic Cooperation

Working at the Building Standards Committee familiarised Koiso-Kanttila with the key Finnish architects of the time, and in 1951 he acted as a spokesperson for the Finnish Association of Architects. During the time he spent at the Building Standards Committee he was also able to expand his international connections. In 1950 he familiarised himself with the Nordic building methods and standardisation committees. In 1956 he was able to travel to Germany, Italy and France with the help of a grant he was given, and there he gained knowledge of the industrial design of construction supplies and element building. Travelling widened his perspective on the effects of element building on architecture. As the representative of the Helsinki Building Centre, formerly known as the Permanent Building Products Exhibition, he took part in the conferences and exhibitions held by the international association of building centres (Conferences Permante International des Centres du Batiment) in Rotterdam in 1957, in Brussels in 1958, in Paris in 1959, in Vienna in 1961 and in London in 1962 [19]. During the Nordic Building Forum in 1955 he was put in charge of compiling the exhibition for Nordic building research. The exhibitions at the Nordic Building Forum were jointly organised by himself and Aarne Ervi [3]. Due to his international connections, his knowledge of the neighbouring countries' research facilities and the research done within increased and at the same time he was developing a wider understanding of the building industry and the processes involved.

The Building Standardisation Committee's connections with similar international facilities were strong, especially from early 1950s onwards. It was realised after the war that standardisation was no longer merely a national level task, but an international challenge. Many of the international and Nordic cooperative organisations which cooperated on issues such as classification systems, information services and concept definitions were born at that time[3] [13].

VI. Research

At the beginning of the 1950s, research funding at the Building Standards Committee had gradually become project-based. In practise, all research was connected to projects; however, the research was still aimed at producing RT files. Research was thus a form of funding standardisation. The managing director of the Committee, Egil Nicklin, was mainly involved in acquiring funding sources, but to some extent he also took part in the management of some research projects [9]. Koiso-Kanttila, however, as the Head of the design department, had the chance to get to know the world of research, as four large research projects were undertaken under his management and supervision: the Apartment Building Staircase Study (1954-1956), the Establishing Technical Study of Residential Houses Without a Basement (1955-1958), the Residential Houses' Waste Management Survey (1951-1955) and the Residential Houses' Reinforced Concrete Floor Study (1952-1957). The results of these studies were later seen in the RT files. During the eight years Koiso-Kanttila spent working at the Building Standards Committee, he managed to either create himself or supervise altogether 167 RT files [2], [3].

Creating the RT files was a programmed process. A survey of the research target was done at the Building Standards Committee, where the key national experts on the subject were also identified. Once the RT file draft was deemed ready for presentation by Koiso-Kanttila, it was forwarded to the Committee's collegiate for approval. This collegiate consisted of former directors, architects Vijo Revel, Aarne Ervi and Kaj Englund. In addition to the collegiate, the proposal was also sent to outside experts, facilities or associations for further evaluation. On basis of the comments received from these evaluations the RT file draft was then specified, finalised and prepared for printing. The number of files printed had a five year additional margin. Koiso-Kanttila felt it was especially important to establish close and confidential relationships with outside experts, so that the Building Standards Committee could have the use of their expertise. By doing so, Koiso-Kanttila managed to create a sound, long-term cooperation network within the building industry. Due to his excellent interpersonal skills he was in turn invited to join the VTT (Technical Research Centre of Finland) laboratories' advisory board as a member of the board [3].

Koiso-Kanttila actively wrote articles for publications in the field, such as the magazines Arkkitehtilehti, Rakennustaito and Teknillinen Aikakausilehti, because he saw the sharing of information as an integral part of not only the wider distribution of the RT files, but of changing practises within the building industry. In his articles he discussed new research results in the field and shed light on common practises. He also gave detailed rationalisations as to why the current instructions or regulations should be altered or specified.

At the beginning of the 1950s, household waste disposal was becoming an increasingly important issue. Increased hygiene demands, insufficient landfills and the lack of transport equipment posed somewhat mundane but significant challenges. The primary goal of the Residential Houses' Waste Management Survey of 1955 was to examine the waste disposal systems of apartment buildings. However, lacking a general overview, it was expanded to include waste disposal in residential centres in general. The survey examined the landfill system and waste disposal by means of compost and burning in central waste burning facilities and in small furnaces. The RT files that were based on the research results gave instructions on waste management and standardised a variety of garbage shafts, waste boxes, waste burning furnaces and chimneys [20].

The aims and ideals of the planning gradually changed at the end of the reconstruction period. In terms of small residential buildings this meant that the basements would have to go, as the goals of utilisable space and increased living standards moved the utility rooms to the ground floor. From the economic point of view, giving up the deep concrete foundation decreased building costs significantly, and as a

[3] The currently still active CIB Conseil International du Bâtiment (International Council for Building) was established in 1953, to name but one.

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result there was less space for utility rooms [21]. With the help of funding received from the housing research committee, Koiso-Kanttila was able to undertake a study in the Building Standards Committee on the establishing of small residential buildings without basements (1955-58), in cooperation with VTT and a few other instances. The goal of the project was to solve the technical issues concerning heating and humidity, usually encountered when building small houses. This wide spread research project examined and compared different base floors that had no heating pipes running through them, as well as heated floors. Comparative data had been acquired mostly from research conducted in Sweden and the United States. The conclusion of the study was that both floor types are widely used, and there has been extensive research of the latter type in the United States. Koiso-Kanttila was cautious with research conducted outside Finland, as the humidity and heat conditions for example in the United States varied a great deal from those in Finland. Albeit the heated floor type had been used widely outside Finland, the research had not yet provided clear solutions as to what kind of base flooring was required. Instead, Koiso-Kanttila figured that unheated floors would become the norm in low foundation houses in Finland, and it was his opinion that these types of floors would be safe in the prevailing conditions. However, he did strongly advise against using sealed surfaces such as water and steam proof plastics in unheated floors [22].

At the beginning of 1950s, a study related to definition of storey height was carried out at the Building Standards Committee. Standardisation of residential buildings' storey heights opened up a further possibility for standardisation of staircases and railings[4] [23]. These research projects reflected the way the emphasis of the Building Standards Committee's work was beginning to lean more and more towards building instructions for apartment buildings. The Apartment Building Staircase Study led by Koiso-Kanttila was completed in 1956. There was a real need for the study, as it was quite common that the regulations regarding staircases varied regionally. A series of concepts regarding staircases were also defined and unified during the project, and these were then brought into practise through the RT files. The study included not only examinations of the technical solutions, but also focused on improving of the instructions regarding personal safety and measurements [24]. Many of the views and results of the study, later transferred into RT files, are still evident in Finnish regulations and practises, for instance, in measurement principles.

The Residential Houses' Reinforced Concrete Floor Study was quite demanding due to its vastness, and the study, finished in 1957, did indeed take nearly five years to complete. The study depended on many speciality studies, e.g. studies on floor height, sound proofing, fire-proofing classification and module measurement. The need for such a study was evident, as on-site cast base floors had been used almost exclusively up until the 1950s. The goal of the study was to examine the suitability of on-site cast reinforced concrete base floors in apartment building construction, and also to find the most suitable solutions for use in Finland. Along with the technical qualities, examining the costs was particularly emphasised in the study. However, due to insufficient funding for the research, examination of prefabricated base floors, for which there was a dire need, were forced to be left out. Based on the results, new RT files regarding a load bearing enforced concrete slate and a so-called floating slate base floor were published [25].

VII. Changes in Standardisation Work

Koiso-Kanttila found the work at the Building Standards Committee to be versatilely instructive and inspirational. However, the atmosphere of the Committee turned somewhat sour in 1957, as internal conflicts caused a number or lay-offs and resignations. The disputes had much to do with the definition of the Committee's status, but also partly with the architects' fear of standardisation and modular design becoming overpowering at the expense of architectural quality. In the early stages of standardisation in Finland it was in fact architects, rather than the engineers, who were considered the experts on the work [26], [27].

Numerous memos and statements from the time reflect the impact of the year 1957, later referred to as the year of rebellion, on the Building Standards Committee. Actual basic research on building and construction of apartment buildings was conducted increasingly through funding from the housing research committee from 1956 onwards. Examples of such research were the study on the unification of official and unofficial rules and regulations, the study on modules, the study on the fire technical classification system and the study on small houses without a basement.[5] Through this progress the Building Standards Committee started to gradually develop into a competitor of the Technical Research Centre of Finland (VTT). However, due to Koiso-Kanttila's willingness to cooperate, the relationship with VTT was good, and researchers from both facilities were members of each other's research boards [28]. Some of the architects feared that the Building Standards Committee would slip away from the architects due to the new emphasis on research. Since 1958, the Committee's board meetings started actively discussing changes to the organisation and the clarification of operating principles; there was an increasing desire to bring engineers into the picture[6][19].

[4] The subject was topical in other respects as well, as the first to become a prefabricated element in Finnish building was the staircase. At the end of the decade 50 % of the stairways were built from prefabricated elements.

[5] The housing research committee had been promised new general regulations regarding modules, as well as implementation instructions for the basic construction supplies. The architect working on the project, however, was either not able or willing to perform the study according to instructions. The Finnish Association of Architects assembled a committee on 14.3.1958, with the aforementioned laid-off architect as one of its members, to discuss the general principles of standardisation work.

[6] In the Finnish Association of Architects' annual publication of 1957, Nicklin discusses the operations, development and development needs of the Building Standards Committee in a clear and critical manner. He refers to the disputes that originated from the module regulation process: ”As we are able to undertake the standardisation of building components on a larger scale during the adaptation phase of the module principles in the near future, it is likely that quite little attention will be given to the all-round design of the

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VIII. Transition from the Building Standards Committee into Building Information Group

Koiso-Kanttila took on new challenges in 1958 as he started working for the City of Helsinki. The operations of the Building Standards Committee followed along the lines taken during the previous decade through much of the 1960s, and its operations no longer met the needs of industrial building of the time. Negotiations with the Finnish Association of Building Engineers were undertaken with the agenda of renewing operations. However, the organisational reform was to be slow. It was not until 1963 when the Finnish Association of Architects decided to establish official contact with the Finnish Association of Building Engineers and the Finnish Association of Negotiating Engineers. Changes did not take place until the end of the 1960s, when the organisational reform also targeted the Finnish Association of Architects [9].

The Building Information Foundation RTF was founded in the 1970s in order to continue the work of the Building Standards Committee, and the Building Information Group, responsible for publishing, was established alongside RTF. The actual standardisation work had already been largely completed by that time. The form of the RT files was changed more towards guidelines and background information for designers. The actual standardisation work was handed over to the industry of the field, outside the Building Information Foundation. As early as the 1970s, the concrete industry published its BES, a concrete element standardisation system, and later on the steel and timber industries followed suit.

The Building Information Group still aims to improve building practises. It finances and publishes instructions according to which Finnish buildings, bridges and roads are designed and built, properties are managed and decorated, information connections are set up and work is done at building sites. The committees consisting of experts in the field produce building instructions known as RYLs, the general quality requirements of the building industry, as well as instruction files, published by the impartial organisation Building Information Group RTF. [9] Their operations have grown from a handful of architects into a nearly one hundred employee enterprise, with experts from the fields of technology, business and the humanities.

Acknowledgment

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[17] *Suomen liike-elämän arkkitehtuuria.* Helsinki, Suomen Arkkitehtiliitto, 1954, pp. 106-107.
[18] *Teollisuuslehti* 6-7/1955, 302-303.
[19] E. Koiso-Kanttila, "Euroopan pysyvien rakennusainenäyttelyiden välisestä yhteistoiminnasta", *Rakennustaito Magazine* 18/1957. 507-509.
[20] *Asuintalojen jätehuoltotutkimus.* Helsinki: SAFA, Standardisoimislaitos, 1955.
[21] *Kellarittoman pientalon perusteknillisiä näkökohtia*, Helsinki: SAFA, Standardisoimislaitos, 1956.
[22] E. Koiso-Kanttila, "Maanvaraislattioita koskevia näkökohtia", *Teknillinen aikakausilehti* 24/1956, pp. 598-602.
[23] E. Mäkiö, "Rakennustekniikan murros", in Nikula Riitta (ed.). *Sankaruus ja arki. Suomen 1950-luvun miljöö*. Helsinki: Suomen rakennustaiteen museo, 1994, pp. 61.
[24] E. Koiso-Kanttila, "Asuntokerrostalojen portaiden mitoittamisesta ja kustannuksista sekä portaita koskevien määräysten yhtenäistämisestä", *Rakennustaito* 4-5/1957, pp. 100-115.
[25] *Asuinkerrostalojen teräsbetonivälipohjatutkimus*, Helsinki: SAFA, Standardisoimislaitos, 1958.
[26] Memos of the committee assembled by the Finnish Association of Architects regarding the principles of standardisation work 25.4.1958 and 27.10.1958.
[27] A letter by E. Koiso-Kanttila addressed to the SAFA board of directors regarding the reasons behind the lay-offs at the Building Standards Committee, undated.
[28] M. Tiula, "Arkkitehtiliiton standardisoimisen aika", in Tiula Martti (ed.). *Rakennustiedon historiikki.* Helsinki: Rakennustieto oy, 2002, pp. 58-60.

components, but rather the joining measurements of the components will be given emphasis, in other words, those measurements that are fundamental in order to be able to join the components into other components or building products."