HOMOGENOUS HOMES OF FINLAND: ‘STANDARD’ FLATS IN NON-STANDARDIZED BLOCKS

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Abstract

Several authors have successfully created and employed vintage cohorts and housing typologies in research addressing energy renovation needs in the existing dwelling stock. This paper suggests that the idea of types would be useful in creating living quality related renovation and adaptation concepts for homes as well. Such concepts could be used for increasing accessibility and individuality of flats and easing life in cramped conditions by means of design. Therefore, the study tests the approach by examining flats' plan design in one cohort: Finnish 1960–80s dwelling stock. The research material consists of plan drawings for 320 apartment blocks with 8745 flats in 51 cities. The study results in recognizing 18 flat types, which are based on ten basic layouts, covering over 80% of all flats in the research material. Although the housing production of this era was characterized by cost-efficiency and industrialized prefabrication technologies, the result can be deemed somewhat surprising. This is because the buildings or their layouts were factually never standardized in Finland, only the production technology was. The identified flat types are estimated to cover as much as one-third of all existing Finnish flats. These findings provide future opportunities for creating new mass-tailored renovation concepts.

1 Introduction

Since Niklaus Kohler and Uta Hassler published their widely cited 2002 paper 'The building stock as a research object,' research interest in the existing housing stock has skyrocketed. As Kohler and Hassler (2002) anticipated, the focus is shifting from new construction to stock management. This is hardly surprising, as the amount of annual new construction represents only a few percent of the whole stock in countries with mature housing stocks, such as Finland (Hassler, 2009). However, to create sustainable policies for managing the existing housing stock, sufficient knowledge about that stock is first needed. Obviously, the complexity and vastness of the building stock makes it a challenging research object (Kohler & Hassler, 2002). Many authors have successfully employed vintage cohorts – extracts of the stock characterized by building type and construction decade – in structuring the research work.

With stock management as the new paradigm, the research interest underpinning the creation of vintage cohorts lies, naturally, in life cycle extension. What kind of information should be included in a cohort depends on the intended use of the data. The research has so far encompassed especially the energy consumption of existing buildings together with the parallel need for refurbishment (Kohler, Steadman & Hassler, 2009). For instance, Theodoridou, Papadopoulos and Hegger (2011) have presented a typological classification for Greek housing to promote energy renovations; Famuyibo, Duffy and Strachan (2012) have formed types from the Irish housing stock that include the building type, structures and U-values to form a basis for policies on retrofits; and Holck Sandberg, Sartori and Brattebø (2014) have processed the Norwegian dwelling stock into five age cohorts and two building types in order to investigate future energy renovation needs. Muraj, Veršic and Štulhofer (2014) have taken the approach even further by presenting 'model buildings' with typical plan layouts and façades to portray blocks of flats from different periods.

However, obsolescence is not only a question of technical performance (Thomsen & van der Flier 2011). It is also a matter of changing needs and preferences that are rooted in demographic changes and evolving housing cultures. When a housing stock does not respond to these needs, 'social obsolescence' may occur. According to Kohler and Hassler (2002), this phenomenon has already led to vacancy problems and demolitions of even recently refurbished blocks in Central Europe. For instance, the demolition of the infamous Biljlmermeer housing estate in Amsterdam has been taken as evidence of the failure of the modernist housing ideals. To understand such phenomena better, housing stock studies should also aim at creating in-depth knowledge about the qualities of existing homes themselves, not only the structures that surround them. For example, knowledge on flat distribution, room distribution, flat layouts and room configurations could be highly useful for facilitating home modifications and improvements that correspond to current needs and preferences. Mass-tailored refurbishment concepts based on typical homes could help to increase accessibility and individuality of flats and ease life in cramped conditions.

Therefore, this paper suggests that cohort creation may be extended to apartment layouts, thus adapting to multiple scales. The study tests the idea with the 1960–80s cohort of Finnish apartment blocks. In Finland, this vintage is of high importance due to its sheer size: it accounts for 40% of all Finnish homes (Hassler, 2009). The physical repair need in this part of the stock has been acknowledged (e.g. Lehtinen, Nippala, Jaakkonen & Nuuttila, 2005). Some attention has also been paid to the significance of changing demographics, mainly the ageing of population (e.g. Lankinen, 1998; Sorri, 2006) and increasing multiculturalism (e.g. Dhalmann, 2011; Maununaho, 2012). Although the layouts of the buildings and flats are factually non-standardized, the stock is nevertheless considered to be monotonous (Hytönen & Seppänen, 2009, p.116). Therefore, the hypothesis is that the flat design is also repetitive, at least to some extent. The motivation for the research work is in utilizing the repetitive nature of the stock in conceptualizing how these homes could respond to the ever-growing individualization requirements for housing. This paper creates the basis for later work that is to encompass the needs of the elderly as well as those of larger households.

2 Background

2.1 Typological approaches

Geometry-based taxonomies, such as typology, morphology and typomorphology, are established methodologies for the systematization of architectural knowledge. They stand for the study and classification of built forms. Typology usually refers to buildings; typomorphology is associated with urban forms; and morphology appears in both contexts. Madrazo (1995) and Krokfors (2006) have performed extensive literature reviews on the history of types and typology in architectural theory. The term 'type' has had several definitions within the discipline (Madrazo, 1995; Krokfors, 2006). Although the term did not emerge until early 19th century, the idea of types has been embedded to architectural theory since Vitruvius. In the 1960–70s, typology drew the attention of theorists such as Giulio Carlo Argan and Aldo Rossi, among others. (Madrazo, 1995). According to Argan, the type is a principle that allows variation. Types are not fixed a priori but deducted from a series of cases. Therefore, the creation of a type depends on the existence of similar instances, and a type result from confronting and fusing all of them. (Argan, 1963). Rossi considered typology as the means to construct a scientific basis for architecture (Madrazo, 1995).

More recently, for example Francescato (1994) and Lawrence (1994) have discussed typology as a means of scientific investigation. Although typology is usually employed to examine the existing stock, it can also be employed for developing new buildings (e.g. van der Voordt, Vrielink & van Wegen, 1997) as suggested by Raphael Moneo (1978, as quoted in Krokfors, 2006). Typology is especially popular in historical research (e.g. Caniggia & Maffei, 2001; Vissilia, 2009; Mashadi, 2012), but Ju, Lee and Jeon (2014) have studied the typologies of plans in contemporary Malaysian apartment buildings and flats. Since the 1980s, graph theory (Steadman, 1983; Roth and

Hashimshony, 1988) and computer-aided analysis methods have provided new tools for typological research.

2.2 Research on Finnish vintage cohorts

In Finland, work with vintage cohorts began in 1985, when a vast research project was initiated to create material for renovation education. The research focused on load-bearing frames, structures and HVAC systems of blocks of flats from 1880 to 2000; the first results of this study were published in 1990 and the last in 2006. The study divided the housing stock into four cohorts: 1880–1940 (Neuvonen, Mäkiö & Malinen, 2002); 1940–60 (Mäkiö et al., 1990); 1960–75 (Mäkiö et al., 1994); and 1975–2000 (Neuvonen, 2006). Of these, the last two are of interest for the current study. The 1960–80s residential cohort has also been thoroughly studied regarding its durability properties, deterioration of structures and repair needs (e.g. Lehtinen et al., 2005; Lahdensivu, 2012; Lahdensivu, Mäkelä & Pirinen, 2013a; Lahdensivu, Mäkelä & Pirinen, 2013b) and energy performance (e.g. Linne, 2012; Uotila, 2012; Lahdensivu, Boström & Uotila, 2013).

2.2.1 1960–70s cohort: technical properties

All the aforementioned publications concentrate on the technical properties of the vintages. During 1960s and 1970s, four basic structural systems were used: brick walls; concrete columns; concrete walls; and concrete crosswalls. With a 60% share, the most common was the concrete crosswall frame, which could be cast *in situ* or prefabricated partially or fully. The facades were usually prefabricated three-layer sandwich panels. Both strip panels and room-size square panels were used, but the latter were more usual. (Mäkiö et al., 1994, p.53–55). Until mid-1970s, slabs were most often *in situ* cast. After 1975, prefabricated hollow-core slabs started to take over (Mäkiö et al., 1994, p.71–74). Connections, tolerances and a modular arrangement were standardized in 1969 and taken into use during the 1970s (Hytönen & Seppänen 2009, p.96–98). Practically all buildings were equipped with central heating (district heating or an oil boiler) at that time (Mäkiö et al., 1994, p.214). The ventilation was natural or mechanical exhaust ventilation, typically with shared ducts (Mäkiö et al., 1994, p.220). As the construction techniques and the HVAC systems of the era are already covered well, they have been left outside the scope of the current study. However, the present literature provides only little insight into apartment layouts.

2.2.2 1960–70s cohort: plan design

Regrettably, existing studies that focus on adaptation of flats or refer to typical buildings fail to utilize large enough samples to have potential for generalization. Mäkiö et al. (1994, pp.166–176) present plan drawings for 43 landings with 138 flats from 1960 to 1974. These are described as 'examples of apartment blocks' that 'represent the annual amount of construction and the frequency of frame and façade types in different years.' Examining the plans, one could argue that rather the aim might have been to include many different layouts. Also Pärnänen, Vaarna and Kukkonen (1994) studied the renovation possibilities of apartment blocks from 1946–72. They describe their ten case study buildings and the flats in those as 'the most common' and 'the most typical,' without presenting any evidence for the claim (Pärnänen et al.,1994, p.3).

In the 2000s, the suitability of blocks of flats from 1950–80s was examined for housing senior citizens (Sorri, 2006). This study utilized ten buildings, which were selected for 'representing the cohorts as well as possible' (Sorri, 2006, p.25). Although the accessibility problems of the flats are evaluated, the report does not present any layouts. Even more recently, two publications by the Finnish Association of Civil Engineers promoted nine apartment blocks with 248 flats to 'model buildings.' They are stated to be typical representatives of 1970s construction in terms of the type and extent of serial production and the responsible construction company (Rantala, 2008, 2009). Once again, no statistical basis for these claims is presented. The aforementioned studies seem to have based their selection of typical cases on educated guesses. Obvious benefits for generalizability could have been achieved by investigating the typical layouts with data. This paper bridges this gap in knowledge.

2.3 Influence of design guidance

Although the plans have not been studied systematically before this paper, erstwhile design guidance can provide some insight into the plan design. Construction was guided by binding norms and instructional guidelines (Mäkiö et al., 1994, p.240). The norms set the minimums for flat size (20m^2), room size (7m^2), room height (2.5m) and floor height (2.8m) (Mäkiö et al., 1994, p.242). In practice, room heights were 2.5–2.6m because intermediate floor structures were 200–300mm thick (Mäkiö et al., 1994, p.71–74).

Flat distribution was guided by the Tax Relief Act of 1962. To receive the tax relief, none of the flats could exceed 120m^2 and the number of small flats (<50m^2) could not exceed one-third. (Mäkiö et al., 1994, p.255). The areas of flats were guided by the guidelines for publicly subsidized blocks as Table 1 shows. These guidelines also provided instructions for the width of the living room and hall. The former was to be at least 3.3m (–1970) or 3.6m wide (1970–), and the latter at least 1.5m wide. The minimum room area was set at 10m^2 but no other guidelines were given on the dimensions of other rooms. (Mäkiö et al., 1994, p.194).

In 1968, the Finnish National Housing Board recommended using prefabricated building parts in publicly financed housing. In practice, the recommendation led to the standardization of dimensions and products in privately financed construction as well (Korpivaara-Hagman, 1984; Keiski, 1998). Furthermore, Mäkiö et al. (1994) state that the difference between publicly and privately financed flats is mainly in the materials used in interior finishing, as opposed to, for example, layouts and dimensions.

Besides the guidelines provided by officials, good construction practices have been promoted in the RT Building Information File since 1943. The RT File, which is still updated and widely used, was founded by the Finnish Association of Architects for post-war reconstruction. It has been published by a non-profit foundation since 1972. (Mäkiö et al., 1994, p.278). At that time, the File provided space requirements for furniture and equipment in living rooms, bedrooms, kitchens and bathrooms (RT 930.10, 1965; RT 930.20, 1974; RT 930.30, 1974; RT 930.40, 1974; RT 930.50, 1974; RT 935.50, 1966; RT 936.50, 1965), but instructional layouts were given only for bedrooms (RT 935.50, 1966; 50 configurations) and bathrooms (RT 936.50, 1965; 26 configurations).

Number of rooms	**Recommended area (m^2)**
1	30–35
2	45–65
3	65–80
4	80–100
5	100–120

Table 1. Recommended areas for publicly subsidized flats (Mäkiö et al., 1994, p.194).

2.4 Influence of societal conditions

As shown above, design guidance did not restrict plan design notably. The erstwhile societal conditions may act as another explanatory factor. Finland industrialized and urbanized much later and, as a consequence, more rapidly than most European countries. In the beginning of 1950s, 70% of the Finnish population still lived in rural settings, but the economic structure was changing drastically. The significance of agriculture as the means of livelihood diminished while industries and services were growing rapidly. Simultaneously, large generations born right after WWII were becoming independent and entering the working life. This resulted in an unprecedented wave of migration to cities between 1969–75, later titled ‘the Great Migration’. (Laakso & Loikkanen, 2004, pp.23–25).

As a result, quantitative goals replaced qualitative ones in housing production. In order to solve the housing shortage, developers were given control over the design and manufacture of buildings and entire neighbourhoods. Architects lost their influence on housing design. The new prefabricated construction technology dictated much of the flat layouts, such as room spans, and favoured straightforward, no-nonsense plans. Although the introduction of long-spanning hollow-core slabs freed flats from load-bearing interior walls in the 1970s, that was not considered as a major change for architects' working conditions. (Mäkiö et al., 1994, pp.177–180). Few parties controlled construction: in late 1970s, only 15 manufacturers were responsible for producing 75% of all panels. Critique for anonymous mass housing, which had begun around 1970, increased towards the end of the decade and started to have cash-flow consequences for the concrete industry. In late 1970s, the industry re-engaged with architects to respond to the call for individuality. Consequently, the 1980s denoted developments in concrete construction. In early 1980s, this work focused largely on facades. (Hytönen & Seppänen, 2009, pp.114–116,137–139,177–183). At the same time, the scale of neighbourhoods started to decrease and the variation of building volumes and types to increase. The postmodern architecture of late 1980s was the peak of this development. In early 1990s, an economic recess resulted again in increased building size and decreased individuality. (Neuvonen, 2006, pp.213–220).

3 Research material and methods

The primary research material for the current study was gathered from the archives of the Housing Finance and Development Centre of Finland (ARA), the government agency for funding public housing. The material consists of architectural drawings that were used for applying for state-supported construction loans. These are sets of general arrangement drawings i.e. floor plans, site plans, elevations and sections. The sample consists of 320 drawing sets picked from 51 cities. The material covers 8745 flats, which corresponds to 4.4% of the stock. The sample size was guided by the sample size Mäkiö et al. (1994) used for studying structures (270 buildings). With regard to plans, the sample is 35-fold to the largest sample in preceding research (Rantala 2008 & 2009: 248 flats). All the material was analyzed, although it reached saturation i.e. a state in which 'no new or relevant data seem to emerge regarding a category' (Strauss & Corbin, 1990, p.188) early on.

The majority of the selected buildings, 260 blocks of flats, are located in 43 neighbourhoods in 15 cities participating in ARA's Development Programme for Residential Areas in 2013–2015. These districts were chosen to the programme by the host cities. Buildings were picked from each district with suitable candidates to maximize geographical and annual coverage for 1968–1985 (emphasizing the 1970s). 1968 was chosen for being the year the Finnish National Housing Board first required using prefabricated building components when financially advantageous (Korpivaara-Hagman, 1984). 1985 marked the end of the national housing programme for 1976–85 and was also the year a new law for improving the state of housing was given, including increased attention for inhabitant participation (Asuntohallitus, 1984, pp.35–36; Valtion asuntorahasto, 1999, p.17). These years are the years the projects were granted loans. This not only makes analyzing the information easier by eliminating the need to research dates of completion, but also improves the accuracy of the results for the purposes of this study: every building represents the erstwhile design practices regardless of the time taken by the construction.

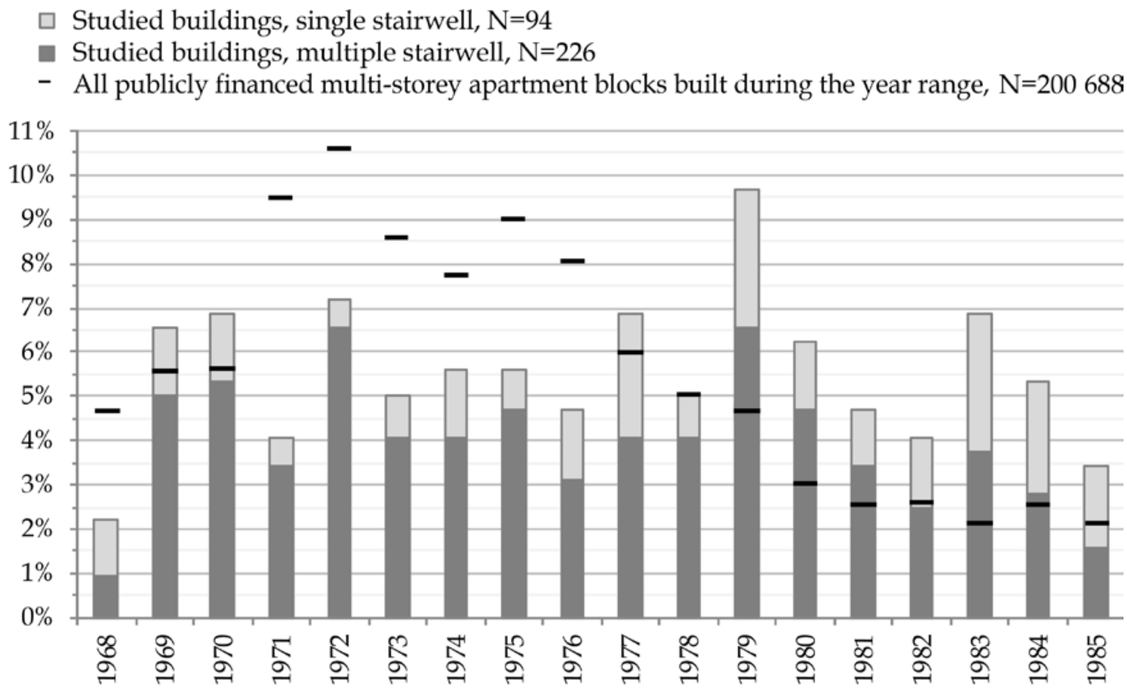

Figure 1. Distribution of studied buildings and all public-funded apartment buildings within the chosen year range. Sources: Authors' research; Kakko, 2011; Laine, 1993.

An effort was made to roughly balance the building type distribution to slab blocks and tower blocks by using a ratio of 3:1 (see Figure 1). Based on a comparison sample (N=1125) acquired from ARA's Register of Real Estate (2013), tower blocks were slightly overrepresented among the studied buildings compared to all contemporary publicly funded production with their portions being 29.4% and 24.3% respectively. As some flat types are noticeably more common in either slab or tower blocks, this has a slight effect when considering their prevalence in a wider context.

Other characteristics, such as tenure type, targeted demographic (students, elderly or disabled people etc.), number of floors, or possible later renovations were not considered. Although the sample was not picked totally randomly, the selection was random from the viewpoint of the subject of study, i.e. flat types and distribution. There is no reason to believe that these factors would have affected the selection of the neighbourhoods for the Development Programme.

Additionally, floor plans for 216 flats – three per each year and room count used in this study – were gathered from the Finnish housing and property sales website Etuovi.com (2014) in order to perform a comparison between different tenure types. The sample contains both publicly and privately financed owner-occupied apartments. To further investigate the generalizability of the research material and the applicability of the types, comparisons were made to ARA's Register of Real Estate (ARA, 2013), official statistics of Finland (OSF, 2007; 2013) and statistics presented in literature (Laine, 1993; Kakko, 2011). For each of these, the samples contained all comparable dwellings for which the relevant data was available.

3.1 Defining the flat types

The method is a simple application of graph theory (see e.g. Roth & Hashimshony, 1988). To simplify the process, only one floor plan for each building was studied when determining the flat types. In the vast majority of cases, all residential floors had identical layouts. If the ground floor plan differed from the rest, the distinction tended to be absence of some flats in favour of common areas, not differing flat layouts. Therefore, the results obtained using this method can be considered representative of the general flat type range within the studied material. Using a graphics program, flats with different room counts were first highlighted in floor plans as Figure 2 shows. Next, the plans of the flats were turned into line-weighed, colour-coded graphs with transparent backgrounds. The graphs were piled on top of each other to identify recurring room layouts as seen in Figure 3. This examination was repeated until the remaining flats were too dissimilar to form any more distinctive types. The consideration of structural elements was limited to load-bearing and non-load-bearing walls. The walls between flats are load-bearing with virtually no exceptions, but inside the unit, the structure can vary more. The most common situation is pictured and possible variation noted in text. The dimensions and door and window locations later shown in the plans of the flat types are mean values determined visually from the piled graphs.

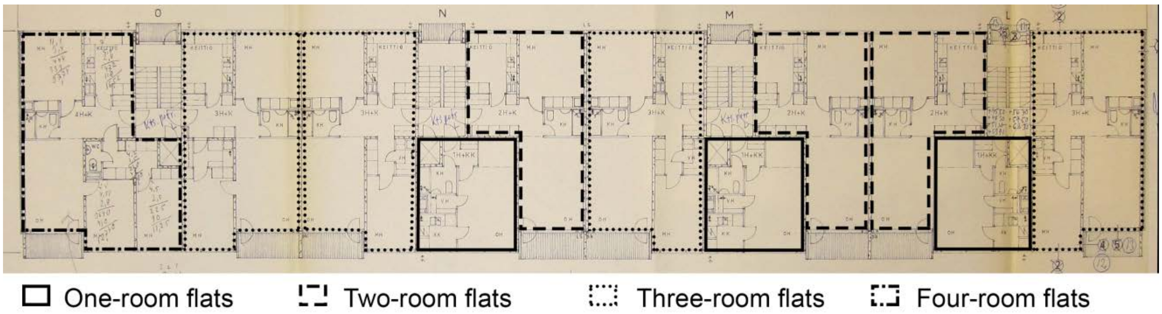

Figure 2. A building plan with flats of different room counts highlighted with simple graphs. Notes: Notes: Kitchens and kitchenettes do not count as rooms. This image is based on a photo of the original document from 1969 provided by the archives of the Housing Finance and Development Centre of Finland (ARA).

Figure 3. A pile of colour-coded graphs for flat type 2-1A. Line weights and colours distinguish different elements of the plan. In the image, the graphs have been aligned along the circled bathroom wall. The colour key also applies to Figures 4–8.

Flat types were only defined for apartments with four or fewer habitable rooms. The proportion of these flats is 99.9% in the research material and 99.7% in a sample of 163 530 public-financed rental flats from the corresponding years (ARA, 2013). According to Laine (1993), even though owner-occupied flats are on average larger than rental flats, their predominant type still has only three rooms. Additionally, based on the research material, variation in flat layouts increases with room count, which decreases the applicability of typology, even if types could still be defined.

Renovation possibilities were a major consideration in grouping the flat layouts. This led to a hierarchical categorization tree in which flats are sorted based on various qualities that affect the feasibility and cost of renovations. The primary categorization criterion was the number of habitable rooms, i.e. excluding the kitchen, bathroom, hall, walk-in closets etc. Based on the research material and considering the most common building frame systems of the time, most habitable rooms are surrounded by at least three walls that are either load-bearing or exterior walls (Mäkiö et al., 1994). As the rooms themselves are of fairly standard sizes, the amount of space – and the way it is partitioned – is mainly a function of the room number.

The secondary categorization criterion was the general room layout. Due to the aforementioned prevalence of load-bearing walls, the sizes and locations of most rooms are rather fixed, barring extensive structural work. This step considered the location of all habitable rooms as a whole, allowing variation in the placement of functions.

The tertiary categorization criterion was the location of the bathroom. Since the bathroom usually determines the location of vertical drainpipes, it has a major effect on the feasibility and cost of changing the room layout during renovation. Changes to the bathroom floor – altering the layout, enlarging the room or making a new one – also often affect the flat below due to horizontal drains running inside the floor, which emphasizes the importance of the room in single-flat renovations. Possible separate toilets were not considered when one was also present in the bathroom. Based on the above criteria, the recognized flat types are identified with a tag 'X–YA' in which

- 'X' is the amount of habitable rooms in the flat, the primary categorization criterion.
- 'Y' is an identifier for the flat's main type, based on the secondary categorization criterion.
- 'A' identifies the subtype of the flat when applicable, based on the tertiary categorization criterion.

4 The typology of flats

Using the criteria defined above, ten distinct main types were identified and further divided into eighteen subtypes. These are listed in Table 2, along with figures on their distribution. Overall, the flat types cover 80.4% of all flats in the studied buildings. Their proportion of all flats in the sample correlates somewhat with the proportion of flats with different room counts: the more prevalent the flat size, the greater the proportion of recognized flat types within it. This could indicate higher proportion of standardized plans within rental flat production, in which two-room units are especially common (ARA, 2013; Laine, 1993). However, due to the sample size and not knowing the tenure types of the studied buildings, causation cannot be stated. It is also likely that the drop in the proportion of recognized flat types from three- to four-room units would be less severe with a larger sample size: there were four-room flats that were very similar to the smaller types but not numerous enough to justify defining a type. As Table 2 shows, each main type has a subtype that is significantly more common than the others. Additionally, each room count has a clearly dominant flat type, the '–1A.'

4.1 One-room flats

Figure 4 presents one-room flat types. Type 1–1 is overwhelmingly the most common, covering 71.1% of all one-room flats. The share of 1–2 is 5.8%. As could be expected due to their small size, the flats do not vary much in shape or layout. Deviation from a square plan usually occurs as elongation along the façade. All the studied flats – within the research material and the various comparison samples – have only one wall with windows and are located between other flats, never in a corner.

Flat type	Distribution of recognized flat types within same room count			
	Slab & tower blocks combined	Slab blocks	Tower blocks	Excluding special housing*
1-1A	56.4%	61.8%	43.4%	61.1%
1-1B	14.7%	8.8%	28.8%	14.2%
1-2	5.8%	8.3%	0.0%	5.4%
All 1 room flat types	76.9%	78.9%	72.3%	80.7%
Other 1 room flats	23.1%	21.2%	27.7%	19.3%
2-1A	35.0%	46.6%	5.5%	37.2%
2-1B	2.1%	2.9%	0.0%	2.3%
2-1C	4.4%	5.7%	1.1%	4.0%
2-2	21.6%	6.7%	59.3%	23.0%
2-3A	12.5%	16.1%	3.5%	11.1%
2-3B	6.5%	6.3%	7.1%	5.7%
2-3C	2.0%	2.3%	1.1%	1.8%
All 2 room flat types	84.0%	86.6%	77.5%	85.2%
Other 2 room flats	16.0%	13.4%	22.5%	14.8%
3-1A	40.2%	57.3%	2.9%	39.5%
3-1B	6.8%	9.9%	0.0%	6.9%
3-1C	6.0%	8.7%	0.0%	6.4%
3-2	23.7%	3.0%	70.6%	25.5%
3-3	5.4%	7.5%	0.8%	5.5%
All 3 room flat types	82.0%	85.4%	74.2%	83.9%
Other 3 room flats	18.0%	14.7%	25.8%	16.1%
4-1A	34.9%	39.7%	9.7%	34.0%
4-1B	14.1%	16.7%	0.0%	15.0%
4-2	4.6%	0.5%	26.4%	4.9%
All 4 room flat types	53.6%	53.6%	36.1%	54.0%
Other 4 room flats	46.4%	43.1%	63.9%	46.0%
All flat types	80.4%	82.8%	74.2%	82.2%
Other flats, 1–4 room	19.5%	17.2%	25.8%	17.8%
>4 room flats in Sample	0.1%	0.2%	0.0%	0.1%

Table 2. Distribution of different flat types within research material. * Excluding special housing that in the studied drawings was specifically marked as being designed for students, disabled people or the elderly.

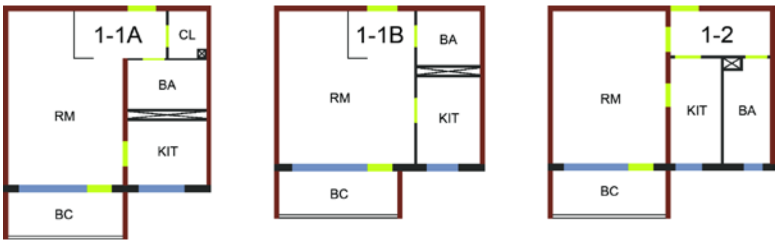

Figure 4. One-room flat types.

4.1.1 Main type 1–1

Main type 1–1 appears in both slab and tower blocks with subtype A being more common in slab blocks and B being more common in tower blocks. In slab blocks they are generally between types 2–1 and 3–1, in tower blocks between 2–2 and 2–2.

4.1.1.1 Subtype 1–1A

The most common one-room flat type consists of a single main room next to which are the kitchenette, the bathroom and sometimes a walk-in closet. The wall bisecting the flat is load-bearing slightly more often than not. How far it extends beyond the sides of the bathroom varies: sometimes the kitchenette is completely open to the room or the hall lies behind the wall in the corner of the flat, displacing the closet, though especially the latter is rare. The dimensions of the duct between the bathroom and kitchenette vary, but an oblong shape is the most common.

4.1.1.2 Subtype 1–1B

The different hall location of subtype B means the routes inside the flat are slightly more straightforward than in subtype A. In this flat type the wall bisecting the unit is very rarely load-bearing. Open kitchenettes are also more common than in subtype A, though still rarer than closed versions.

4.1.2 Main type 1–2

Unlike 1–1, main type 1–2 only appears in slab blocks. The routes between the rooms are the same as in 1–1, with the addition of a door between the kitchen(ette) and the hall, although the actual layout differs significantly. Because the kitchen(ette) and bathroom are next to each other along the façade and the hall is squished behind them, all rooms except the main one tend to be long and narrow. The wall separating the main room is always load-bearing, although it does not always extend all the way to the back wall.

4.2 Two-room flats

Two-room flats, being the most common room count in the research material, also have the highest number of definable types (see Figure 5). Likely related to this, they also have the highest percentage of flat type coverage: 84.0%. 2–1 is the most common by far, covering 41.4% of all two-room flats, with 2–2 and 2–3 following behind with 21.6% and 21.0% respectively. Unlike one-room units, two-room main types are rather clearly divided between building types. Each main type has its distinctive shape stemming from its location in relation to the building and stairwell.

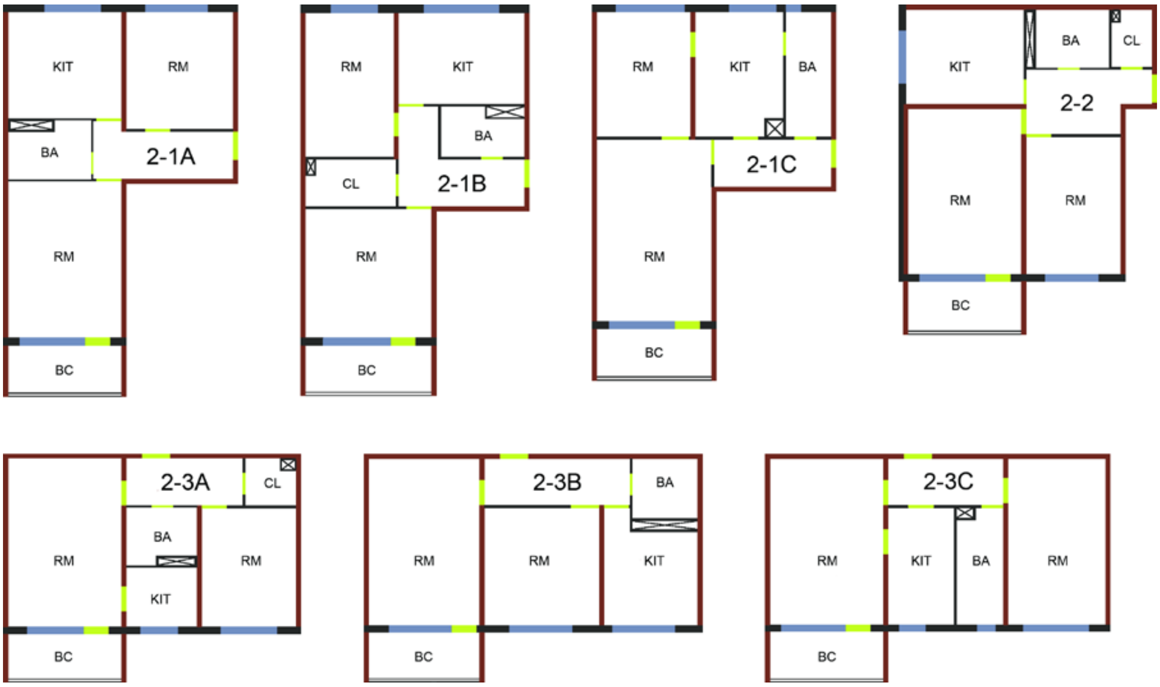

Figure 5. Two-room flat types.

4.2.1 Main type 2–1

The most common two-room main type generally appears in slab blocks. It spans across the building and is usually located opposite to an identical flat with a one-room flat in-between or next to a single type 3–1 flat. All the flats in the main type only open in two directions, regardless of their position in the building. Inside the flats, the rooms are mainly located based on their need for a window, which places the habitable rooms next to façades with the hall, bathroom and possible walk-in closet in the middle. As is logical from a technical standpoint, kitchens and bathrooms usually lie next to each other. The size and shape of their shared duct varies, as does the room it is located in. The living room is usually across the hall from the kitchen.

4.2.1.1 Subtype 2–1A

The most common subtype, 2–1A, covers 84.4% of all flats of its main type. In 43.3% of the flats, there is also a walk-in closet next to the bathroom. These tend to have a wider, more irregularly-shaped hall. In a minority of cases, the bedroom is accessed through the adjacent kitchen or living room. The width of the flat varies in both horizontal directions. The only partition wall that may be load-bearing – and usually is – is between the two adjacent habitable rooms.

4.2.1.2 Subtype 2–1B

This subtype only appears in slab blocks and is rare even there. The exact line of division between the hall and kitchen varies, with the short hallway next to the bathroom being part of one or the other. When the hallway belongs to the kitchen, there is either no walk-in closet or it is smaller to allow access to the room in the corner from the hall or the adjacent room. In this subtype, the partition wall perpendicular to the façade appears always to be load-bearing, although the number of studied flats is significantly smaller than for 2–1A.

4.2.1.3 Subtype 2–1C

In this type, all rooms – including the bathroom – are along façades. Therefore, the overall shape tends to be longer in that direction in comparison to the previous subtypes. In roughly half of the flats of this type, the bathroom has a separate toilet at the end, next to the hall with a door in-between. None of the flats have walk-in closets. The partition wall between the kitchen and adjacent bedroom is always load-bearing; for the one next to the bathroom there appears to be an even split.

4.2.2 Main type 2–2

This main type appears almost exclusively in tower blocks, covering 59.3% of two-room units. The few slab blocks it is found in usually differ considerably from the ordinary rectangular shape. In the research material, this flat is most often located in two adjacent corners of a tower block with a one-room unit in between and a pair of type 3–2 flats in the remaining corners. With the same overall layout, two general shapes for the flat were found: the square one shown in Figure 5 and a more oblong variation that is slightly stretched horizontally but still otherwise similar, with the possible exception that the living room is accessed through the kitchen. In most cases, however, all the rooms are accessed through a centrally located hall. The shape of the hall varies, depending mainly on whether there is a walk-in closet in the corner or just an entrance and an extension to the hall area. As usual, the main vertical duct is located between the kitchen and bathroom, varying in size and shape but usually spanning at least two thirds of the length of the wall. The location of the load-bearing walls varies more than in other flat types, except the related main types 3–2 and 4–2. As a general rule, they are parallel to load-bearing exterior walls. The walls within the flat that surround the bathroom and the possible walk-in closet are never load-bearing.

4.2.3 Main type 2–3

The main type 2–3 appear mostly in slab blocks, although not exclusively. Again, exceptions usually occur in tower blocks differing from the standard square shape. The usual location is similar to one-room units: in the middle of the façade, never in a corner. In slab blocks, this generally means that the flat is between two type 2–1 units. Like one-room flats, these units never have windows on more walls than the one shown in Figure 5. Since the type only has one façade wall, all rooms requiring a window are arranged in a row along it with the hall behind them. In most cases, at least one of the walls between these rooms is load-bearing.

4.2.3.1 Subtype 2–3A

For the most part, this subtype appears in slab blocks and often in buildings that also have type 1–1A flats. The similarities between these flat types are obvious with the main difference being the addition of a room. This subtype is by far the most common in its main type, covering 59.5%. The most notable variation of layout is the existence of the walk-in closet in the corner. If the closet is absent, the adjacent room usually extends to the rear wall. In a clear minority of cases, the kitchen has a door on both sides. As in the flat type 1–1A, the duct between the kitchenette and bathroom is usually long and narrow, often spanning the width of the whole wall. What little variation there is in the flat's external dimensions occurs perpendicular to the façade.

4.2.3.2 Subtype 2–3B

This subtype appears roughly equally in slab blocks and tower blocks. It differs from the other 2–3 flats by not having a one-room counterpart and by having a full kitchen. The kitchen can be located next to the bathroom or in the middle. Compared to the other 2–3 subtypes, the dimensions and shape of the rooms vary rather considerably. Either both the partition walls perpendicular to the façade are load-bearing or neither of them is. Both options are equally common. The overall dimensions and the shape of the units also vary more than in most flat types.

4.2.3.3 Subtype 2–3C

The rarest of all the defined two-room flat types is a straight expansion of the one-room flat type 1–2. Therefore, nearly all the statements made about 1–2 apply here, as the extra room is simply added to the side with a door or a doorway to the hall. One exception is that, unlike any of the 1–2 flats, some of the units in this subtype have non-load-bearing internal crosswalls instead of load-bearing ones. Variation in the size and the shape of the units is nearly nonexistent.

4.3 Three-room flats

Three-room flats are the second most common room count in the research material and the comparison sample from ARA's Register of Real Estate (2013). Though considerably fewer in total number than two-room units, their flat type coverage is almost as high: 82.0%. Figure 6 presents the types. The distribution of the flat types is similar to the two-room counterparts with 3–1 at 53.0%, 3–2 at 23.7% and 3–3 at 5.4%. All the flat types are clear and mostly direct continuations of their two-room counterparts, with no noticeable difference aside from the added room. The routes inside the flats rely on a central hall through which all the rooms are accessed. Structural principles also remain unchanged with the added room usually being behind a load-bearing wall.

4.3.1 Main type 3–1

Main type 3–1 is found almost exclusively in slab blocks. It usually appears with types 2–1 and 1–1 or paired with an identical unit. Like type 2–1, 3–1 also spans across the building with the kitchen and habitable rooms next to the façades. The kitchen and the bedroom are usually located next to each other with the living room on the opposite side. No difference in the room size was noticed between the corresponding subtypes of the main types 3–1 and 2–1. The flat only opens in two directions, with few minor exceptions when located at the end of a building.

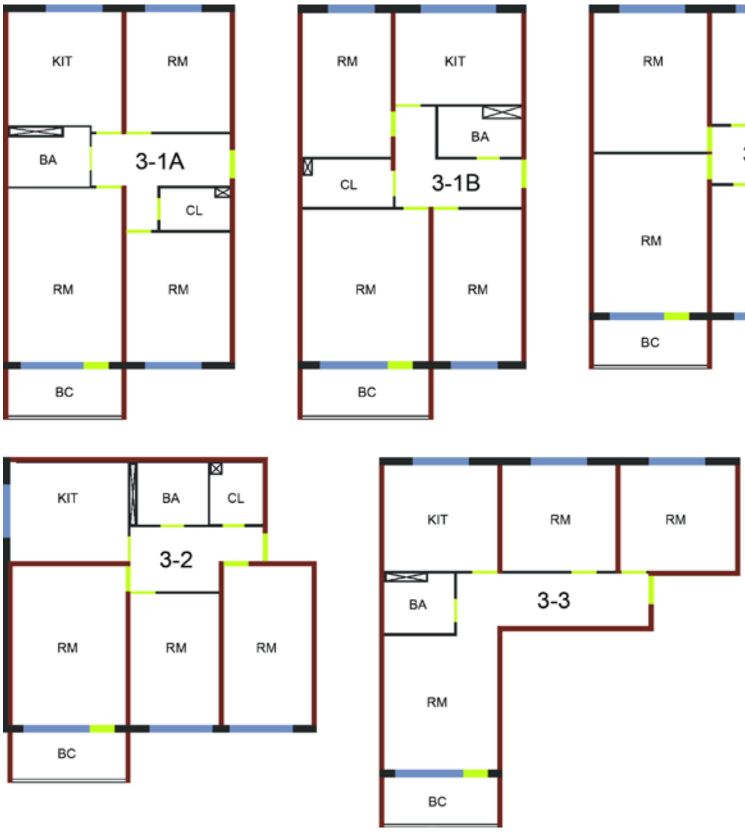

Figure 6. Three-room flat types.

4.3.1.1 Subtype 3–1A

This most common subtype has a fairly similar share of all the flat types in its size group as the corresponding smaller type, 2–1A. As for the layout, everything observed about the type 2–1A also applies, with the obvious addition of one bedroom. This bedroom also often has its own walk-in closet, especially if there is not one next to the bathroom. The partition wall next to the added bedroom and perpendicular to the façade is usually load-bearing.

4.3.1.2 Subtype 3–1B

As with the above subtype, the only difference in layout between this and the smaller type 2–1B is the added bedroom behind a load-bearing wall. Unlike the subtype A, however, this flat type was found to be significantly more common than its two-room counterpart.

4.3.1.3 Subtype 3–1C

In this subtype too, the basic layout is similar to its smaller counterpart, the 2–1C. The hall appears usually to be somewhat larger, but due to the rareness of the type in the sample, this may be coincidental. With the same caveat, all the rooms of this flat type – unlike those of 2–1C – are directly connected to the hall.

4.3.2 Main type 3–2

Like type 2–2, type 3–2 also appears almost exclusively in tower blocks with the exceptions being the slab blocks whose shape is not the usual rectangle. These flats are normally located in two adjacent corners. Like its two-room counterpart, 3–2 occurs in two main shapes: the square one and a more oblong variation. There is no noticeable difference to the flat type 2–2 in the layout, room sizes, connections or structural elements, aside from the added bedroom.

4.3.3 Main type 3–3

Type 3–3 appears virtually exclusively in slab blocks. It is usually paired with a mirrored identical flat and either two type 1–1 flats or one 2–3 flat in-between them, along the balcony façade. Similarly to its closest relatives 2–1 and 3–1, type 3–3 also opens in two directions and is arranged around a central hall. Structural elements are no different from the type 2–1 aside from the added room, which is, again, usually behind a load-bearing partition wall. The main distinction to 3–1 is the location the additional room, which results in a longer hall but does not otherwise change the layout or the connections.

4.4 Four-room flats

Four-room flats are relatively rare in the sample – and the contemporary flat production in general – which presumably is the reason for not identifying many types for them. Figure 7 shows the recognized types. Like its smaller counterparts, the main type 4–1 covers a clear majority of all flats in its size group: 49.0%. The other main type, 4–2, is clearly behind at 4.6%. Among these flats, precise layouts and room dimensions appear to be less consistent than in smaller units. Especially locations of walk-in closets and secondary toilets vary considerably. As before, all types are clear continuations of their smaller counterparts.

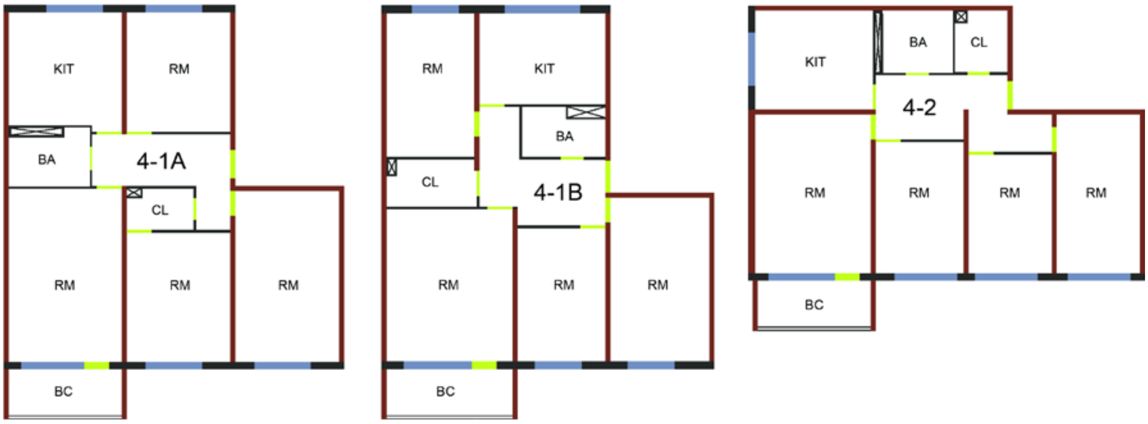

Figure 7. Four-room flat types.

4.4.1 Main type 4–1

Like all the first main types (X–1), 4–1 also occurs mostly in slab blocks. All exceptions to this rule are of the subtype 4–1B. Both subtypes are usually paired with the type 3–1 across the stairwell. With the exception of the added room, all general statements made about the main types 2–1 and 3–1 also apply here.

4.4.1.1 Subtype 4–1A

As with 3–1A, the only difference to the smaller related flat type is the added bedroom, usually with no walk-in closet. Individual rooms, connections between them and structural elements generally remain unchanged.

4.4.1.2 Subtype 4–1B

Everything stated about the subtype 4–1A also applies here. Due to the rareness of the subtype in the already small sample of four-room flats, it is possible that more differences to the smaller flats – such as the number of walk-in closets – could have been observed if the sample had been larger. These kinds of differences, however, are rather insignificant from the perspective of renovation, since they always encompass non-load-bearing structures.

4.4.2 Main type 4–2

Even more than its two- and three-room counterparts, the 4–2 appears virtually exclusively in tower blocks. In the buildings of the research material, there was ever only one 4–2 flat per floor. The layout and connections in 4–2 are similar to its smaller counterpart, as are the load-bearing elements and the dimensions of individual rooms (aside from the hall).

4.5 Flats outside the defined types

Many of the units that remain outside the defined types are clear variations of those. For example, the first and third layout in Figure 8 are very close to 2–1B and 1–1A, respectively. The same appears to be true for flats with five or more rooms, although these are extremely rare. Individual rooms are also similar in shape and size to those of the recognized flat types. Since room sizes are, to a large degree, determined by the frame system used, this could be expected.

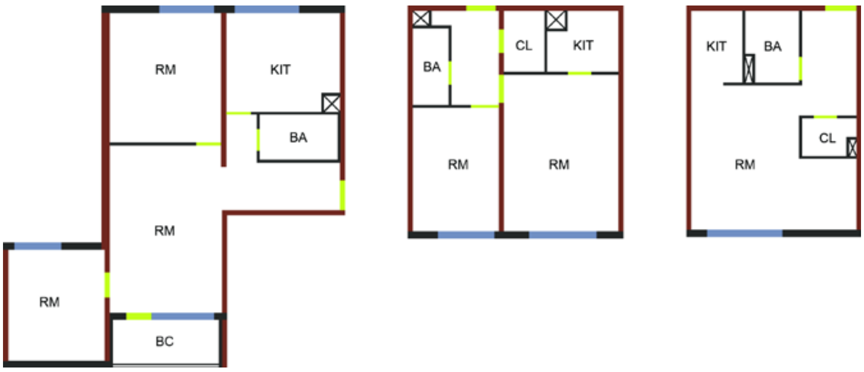

Figure 8. Examples of flats outside the defined types.

5 Discussion

5.1 Representativeness of the flat types regarding the Finnish housing stock

The dominating factor in determining the usefulness of the types is how much of the whole building stock they encompass. Though few in number, the existing applicable works using the concept of typical buildings seem to comply with the flat types defined in this study. Within the chosen year range, Mäkiö et al. (1994) present 15 landings, Pärnänen et al. (1994) two buildings and Rantala (2008; 2009) eight buildings. Table 3 shows the occurrence of the types in them. As in the current study, for each room count, the most common type was the X–1.

Publication	Buildings or landings	All flats	Recognized flat types, % of all	Types exhibited
Mäkiö et al. (1994)	15	138	60.5%	11
Pärnänen et al. (1994)	2	33	81.8%	4
Rantala (2008; 2009)	10	248	100.0%	10

Table 3. Occurrence of recognized flat types in the buildings of previous studies.

In addition, the research material was compared to a sample of flats for sale on Etuovi.com (2014). Table 4 presents the coverages of types for the research material and the comparison sample. The biggest difference appears with the largest flats. This could be expected, since those flats also exhibited the most variance within the research material and obviously have the highest potential for different layouts. Nonetheless, the flat type coverage among different room counts is consistent between the samples: the percentage is highest for two-room flats and decreases for other room counts in the same order. This is also true when considering the coverages of the most common flat types – which are the same in both samples – of all units with equal room count.

Flat room count	Most common flat type		Portion of recognized flat types		Portion of most common flat type	
	Comparison sample	Research material	Comparison sample	Research material	Comparison sample	Research material
1 room	1-1A	1-1A	70.4%	76.9%	59.3%	56.4%
2 room	2-1A	2-1A	81.5%	84.0%	27.8%	35.0%
3 room	3-1A	3-1A	70.4%	82.0%	33.3%	40.2%
4 room	4-1A	4-1A	66.7%	53.6%	35.2%	34.9%
Total			72.2%	74.1%	38.9%	41.6%

Table 4. Occurrence of recognized flat types in random owner-occupied apartments from the years 1968-1985, N=216, and research material, N=8745. Sources: Authors' Research; Etuovi.com, 2014.

Aside from the current research and the aforementioned other studies, there is no data available on the number of specific flat layouts produced. Therefore, determining the correspondence further between the research material and all comparable construction relies on studying more general properties of the flats. This study is divided into a progression of comparison pairs, where each stage widens the context, in order to eventually evaluate the applicability of the types in the scope of all Finnish apartment blocks built during the studied period.

5.2 Correspondence between research material and all comparable publicly financed housing

To detect possible differences in the distribution of flats with different room counts, the research material – consisting of various tenure types – was compared to all the 160 210 rental flats in ARA's Register of Real Estate (2013) for which this information was recorded. The proportions of one-, two-, three- and four-room flats differed by 3.8, 1.3, 4.2 and 0.9 percentage points, respectively. One- and two-room flats were more common in the register than in the research material and vice versa. The difference is presumably due to the prevalence of smaller flats (by room count) in rental production, in which case a large sample with both tenure types should fall more closely in line with the research material. (ARA, 2013; Kakko, 2011; Laine, 1993).

To check for differences in average flat area, a random sample of 30 buildings (209 flats) was picked from the research material and compared to all public-funded flat production in the register for which the information was recorded – 355 172 flats in 12 335 buildings (ARA, 2013). The average areas were 59.9m² and 60.3m², respectively. Unlike the previous sample, this one included all tenure types, which for its part supports the assumption that the difference in room count observed above was due to a dissimilar distribution of the tenure types in the samples.

Considering the extensive regulation of publicly financed projects (Korpivaara-Hagman, 1984) – especially towards the end of the studied time period – and the similarity in flat sizes and room counts, the research material appears to be a rather accurate representation of the publicly funded flat construction of the studied era.

5.3 Correspondence between publicly and privately financed projects

In total, 41.6% of the dwellings in apartment blocks the construction of which began 1968–1985 were financed by the state. As seen in Figure 9, the exact proportion varies; state financed production peaks at 55.9% in 1971 and is 24.9% at the lowest in 1985. As shown in the background, the existing literature (Korpivaara-Hagman, 1984; Mäkiö et al., 1994; Keiski, 1998) strongly suggests that, as far as the applicability of the typology is concerned, there should be no significant differences between publicly and privately financed buildings. To shed more light on this, differences – or lack thereof – were examined in the average area and room count of publicly and privately financed flat production.

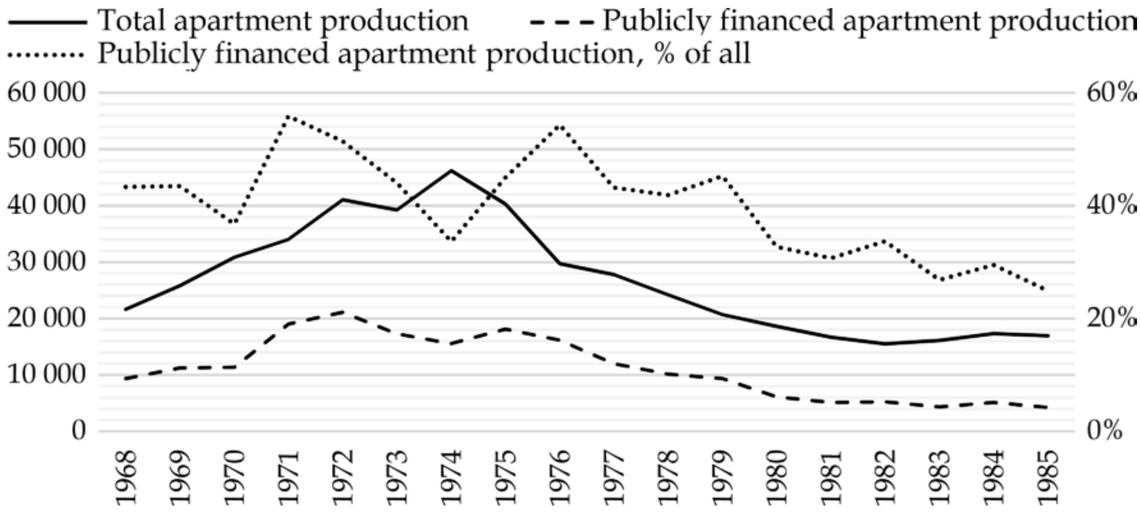

Figure 9. Finnish dwelling production in apartment blocks during the years 1968–1985. Sources: Kakko, 2011; Laine, 1993; Official Statistics of Finland, 2007.

Data on 355 172 publicly financed dwellings from ARA's Register of Real Estate (2013) was compared to statistics on privately financed dwellings built during the corresponding years. Figure 10 presents the comparison. Row houses are included in the numbers to retain comparability because they have been combined with apartment blocks in some of the sources used. Since, at least among publicly financed buildings, the different building types roughly follow the same trends in average area (ARA, 2013), the effect of including the row houses should be minimal for the current purpose. The years used in compiling the statistics vary between the sources: ARA (2013) uses the year the loan for the project was granted, Kakko (2011) and OSF (2007) use the year of completion, and Laine (1993) uses both in different tables and figures. Therefore, the numbers presented are not accurate as annual snapshots, but due to the gradualness of the change, they are usable for examining general trends.

The average area of all dwellings in these building types produced between 1968–85 differs by only 0.7m² between public and private financing, though as Figure 10 shows, this difference is not constant. It is, however, smallest in the mid-1970s, when the amount of total dwelling production in apartment blocks was at its highest. This suggests that the correspondence between publicly and privately financed projects was the greatest during the peak years.

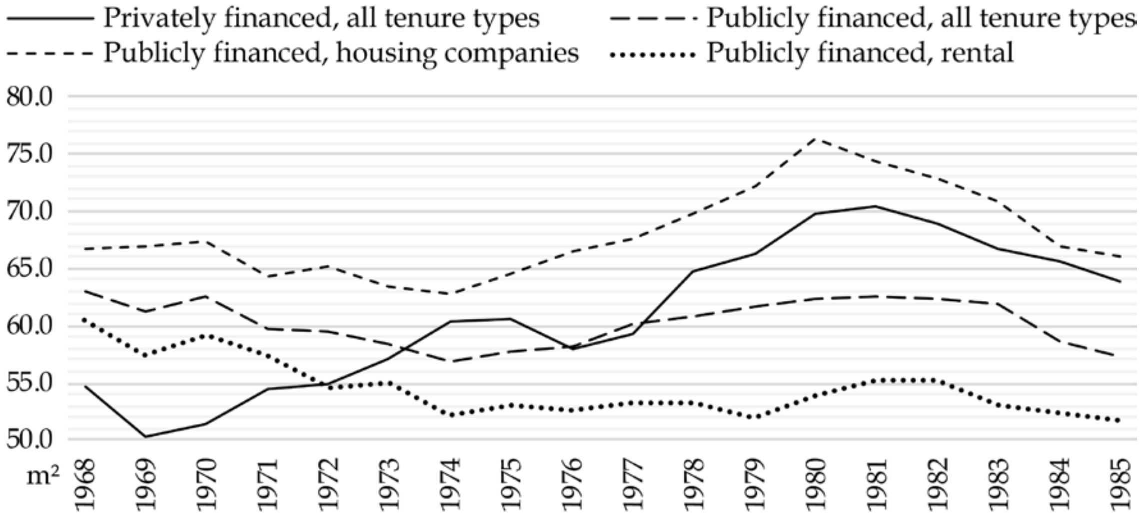

Figure 10. Average dwelling area in apartment blocks and row houses, m². Sources: ARA's Register of Real Estate, 2013; Kakko, 2011; Laine, 1993; Official Statistics of Finland, 2013.

5.4 Correspondence between rental and owner-occupied housing

Figure 10 shows that in the 1970s, the biggest difference in average dwelling area was not between financing methods but between tenure types: in publicly financed projects, the average size of owner-occupied dwellings grew, while rental dwellings initially got smaller and then stayed roughly the same. Tenure-based data is not available for privately financed dwellings, but similar figures seem likely considering the minimal difference in the average area as mentioned above and nearly identical portion of rental dwellings – 57.5% in publicly financed and 59.2% in privately financed production (Statistics Finland, 2014).

When considering the applicability of the flat types – especially from the viewpoint of generalizable renovation plans – it is important to determine whether the difference in the average area stems from a difference in average room size, which likely affects the interior configuration of a flat, or the average number of rooms. Laine (1993) states that during the 1970s, three rooms and a kitchen became the predominant type for owner-occupied flats, while most rental flats still had one or two rooms. Examining a sample of 160 210 rental dwellings in multi-storey apartment blocks from 1968–85 supports what Laine (1993) asserted about rental flats: the average room count is 2.1 (ARA, 2013). As owner-occupied dwellings are on average larger than rental dwellings, as Figure 10 shows, the above suggests that the difference in average area could be explained with different distributions of room counts.

To examine further whether there is a difference in the average areas of flats with equal numbers of rooms but different tenure types, a random sample of 2000 owner-occupied flats (Etuovi.com, 2014) – 500 for each room count – was compared to 152 722 rental flats (ARA, 2013). A sample was also taken from the research material consisting of 90 buildings, spread evenly among the year range and containing 2545 flats in total, including both tenure types. The annual average areas of the aforementioned samples are presented in Figure 11. The average flat sizes for the whole year range were nearly identical in the samples, the largest difference occurring with four-room flats, but even this was only 2.9m². Annual variation in the average areas is minimal in the comparison samples, and even in the research material the variation appears to mainly depend on the sample size: the higher the number of flats examined, the smoother the graph.

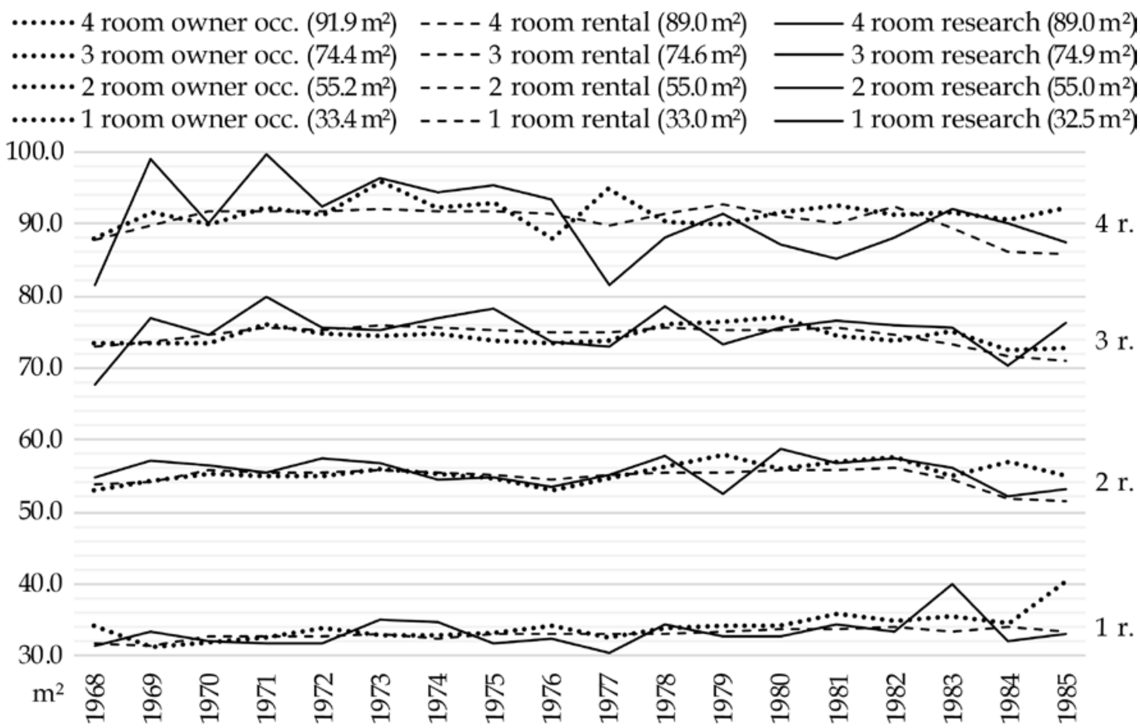

Figure 11. Average dwelling areas in privately and publicly financed owner-occupied flats, publicly financed rental flats and the flats of the research material (both tenure types), m². Sources: ARA's Register of Real Estate, 2013; Authors' Research; Etuovi.com, 2014.

Considering all the above, the difference in the average area does, indeed, seem to stem from rental flats generally having fewer rooms than owner-occupied flats. Therefore, the flat types as well as any refurbishment plans that are to be based on them should be fairly equally applicable to rental and owner-occupied housing.

5.5 Applicability of flat types to the general stock of corresponding buildings

Even if the defined types only applied to publicly financed apartment blocks – with full generalizability within that category – they would still cover 33.5% of the dwellings in apartment blocks whose construction began between the years 1968 and 1985 (Kakko, 2011; Laine, 1993). However, based on the comparisons presented above, the flat types appear equally applicable to the privately financed dwelling stock. This brings their coverage to the figures presented in Table 5 and the total number of covered dwellings to 387 884. In addition, there obviously was no immediate and complete change in housing production at either end of the studied time period. Therefore, the coverage of the flat types should well extend beyond the studied era in both directions. It is also possible that some of the flat plans were used in row houses built with the same production methods due to the similar form of the building floor.

Category	Total number of flats	Portion of recognized flat types
Apartment blocks, built years 1968–1985	482 665	80.4 %
All building types, built years 1968–1985	957 208	40.5 %
Apartment blocks, built 2012 or earlier	1 269 305	30.5 %
All building types, built 2012 or earlier	2 865 568	13.5 %

Table 5. Percentages of flat types in different categories. Sources: Authors' research; Official Statistics of Finland, 2007; Official Statistics of Finland, 2013. Note: Percentages assume full generalizability of the sample amongst apartment blocks of the studied era.

Conclusions

This study introduced the idea of forming typologies of flats from vintage cohorts to facilitate future creation of housing quality related, mass-tailored renovation and adaptation concepts. The approach was tested by applying it to one vintage, the 1960–80s, in the Finnish housing stock. The research resulted in recognizing 18 flat types, based on ten basic layouts, covering 80% of all flats in the data. Depending on the room count, the coverage is between 54% (four-room flats) and 84% (two-room flats). The findings also suggest that in the examined cohort, every third to every second flat in each room count would be identical with the most common flat type of that room count. The hypothesis was that some recursion would occur because this vintage has often been criticized for its perceived monotonousness. Yet, the extent of the repetitiveness was surprising, considering that the buildings or their layouts were never factually standardized in Finland – only the production technology was. If full generalizability of the results is assumed amongst the apartment blocks of the examination period, the recognized types cover as much as one-third of all existing Finnish flats.

Although this paper is the first in Finland in which the selection of representative types has been based on real data, the existing refurbishment studies utilizing the concepts of 'typical buildings' or 'typical flats' already demonstrate the advantages of the current findings. Besides creating new plans, the recognized types also allow evaluating the applicability of these case-based renovation studies for a larger stock of dwellings, thus possibly increasing their utility retroactively. Defining the typology of flats enables shifting from singular case studies to creating mass-customized alteration concepts that fit a wide range of dwellings with minimal modifications. If needed, the level of detail of such concepts could be increased further by studying dimensional variations of individual rooms or flats as whole entities. In addition, understanding the interior configurations of the units helps in studying the possibilities for combining or dividing them. As household sizes have changed considerably since the 1970s and keep doing so, this is a matter to consider when adapting the existing building stock to current and future needs.

On a broader scale, transformation potentials of housing estates or whole neighbourhoods could be evaluated more swiftly by first studying the suitability or adaptability of different flat types for various demographics. This can help to comprehend existing housing and possible development needs in a wider context. In addition to the apartments themselves, understanding which demographics the dwelling stock of a neighbourhood can house is useful in contemplating the extent and qualities of the required local services. When combined with studies addressing the structural properties of the buildings in question, the knowledge on flat types can also be used to better estimate the potential for renovation and the cost of such measures in the current building stock. In all, the types can help residents, designers, real estate managers and policy-makers to recognize the possibilities of existing housing and to better plan their future actions, be they home refurbishments or policy changes.

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References

ARA (The Housing Finance and Development Centre of Finland). (2013). *Asuntorahaston kiinteistörekisteri ARAKIRE* [Register for pieces of real estate that have received public funding]. [Data Set]. Lahti: ARA.

Argan, G. C. (1963). On the typology of architecture. *Architectural design*, 33, 564–565.

Asuntohallitus. (1984). *Asuntotoimen pääpiirteet* [Outline of the housing department]. Vantaa: Asuntohallitus.

Caniggia, G. & Maffei, G. L. (2001). *Interpreting basic building: Architectural composition and building typology* (Saggi e documenti 176). Firenze: Alinea.

Dhalmann, H. (2011). *Yhden uhka, toisen toive? Somalien ja venäläisten asumistoiveet segregaatiokehityksen valossa* [A threat for one, a dream for someone else? The housing preferences of Somali and Russian immigrants in the light of ethnic segregation]. Helsinki: Helsingin yliopisto.

Etuovi.com. (2014). [Portal for homes for sale in Finland]. Retrieved October 30, 2014, from http://www.etuovi.com/haku/myytavat-asunnot

Famuyibo, A. A., Duffy, A. & Strachan, P. (2012). Developing archetypes for domestic dwellings — an Irish case study. *Energy and Buildings, 50*, 150–157. doi:10.1016/j.enbuild.2012.03.033

Francescato, G. (1994). Type and the possibility of an architectural scholarship. In K. A. Frank & L. H. Schneekloth (Eds.), *Ordering space: Types in Architecture and Design* (pp. 253–270). New York: Van Nostrand Reinhold.

Hassler, U. (2009). Long-term building stock survival and intergenerational management: the role of institutional regimes. *Building Research and Information, 37*, 552–568. doi: 10.1080/09613210903189533

Holck Sandberg, N., Sartori, I., Brattebø, H. (2014). Using a dynamic segmented model to examine future renovation activities in the Norwegian dwelling stock. *Energy and Buildings, 82*, 287–295. doi: 10.1016/j.enbuild.2014.07.005

Hytönen, Y. & Seppänen, M. (2009). *Tehdään elementeistä: Suomalaisen betonielementtirakentemisen historia* [Let's prefabricate it: The history of Finnish precast concrete construction]. Helsinki: SBK-säätiö.

Ju, S. R., Lee, L. & Jeon, S-Y. (2014). The typologies of block and unit plan in Malaysian apartments: Focused on middle cost houses supplied by the private sector. *Journal of Asian Architecture and Building Engineering, 13*, 397–404.

Kakko, K. (2011). *Muunneltava lähiöasunto - Lähiökorjaamista asunnon ja asujan näkökulmasta* [Modifiable suburban housing – Fixing the suburbs for the residence and the resident]. Tampere: Tampereen teknillinen yliopisto.

Keiski, S. (1998). *Ikääntymisen ihmemaa: Vertailututkimus vanhusten kokemuksista standardikotikeittiössä, koekeittiössä ja käyttäjälähtöisesti suunnitellussa kotikeittiössä* [The wonderland of aging: A comparative study on the experience of the elderly in a standard home kitchen, a test kitchen and a user-based home kitchen] Helsinki: Taideteollinen korkeakoulu.

Krokfors, K. (2006). *Aika asuntoarkkitehtuurissa: Typologinen joustavuus pientalosuunnittelun uudistamisen välineenä* [Time in residential architecture: typological flaxibility as a means to renew housing design] (Teknillisen korkeakoulun arkkitehtiosaston tutkimuksia 2006/26). Espoo: Teknillinen korkeakoulu, arkkitehtiosasto.

Kohler, N. & Hassler, U. (2002). The building stock as a research object. *Building Research and Information, 30*, 226–236. doi: 10.1080/09613210110102238

Kohler, N., Steadman, P. & Hassler, U. (2009). Research on the building stock and its applications. *Building Research and Information, 37*, 449–454. doi: 10.1080/09613210903189384

Korpivaara-Hagman, A. (1984). *Asuntohallituksen suunnitteluohjeet asuntorakentamisen ohjausvälineenä* [National Housing Board’s design standards as an instruction tool in housing production] Oulu: Suunnittelurengas.

Laakso, S. & Loikkanen, H. A. (2004). *Kaupunkitalous: johdatus kaupungistumiseen, kaupunkien maankäyttöön sekä yritysten ja kotitalousten sijoittumiseen* [City economy: an introduction to urbanization, land use and the geography of enterprises and households]. Helsinki: Gaudeamus.

Lahdensivu, J. (2012). *Durability properties and actual deterioration of Finnish concrete facades and balconies* (Publication 1028). Tampere: Tampere University of Technology. Retrieved from http://URN.fi/URN:ISBN:978-952-15-2823-1

Lahdensivu, J., Boström, S. & Uotila, U. (2013). The effects of different renovation measures on the energy consumption of suburban concrete blocks of flats. In P. Hajek, J. Tywoniak & A. Lupisek (Eds). *CESB 13 Prague: Conference on sustainable building and refurbishment for next generation* (pp. 99–102). Prague: iiSBE Czech & Czech Technical University.

Lahdensivu, J., Mäkelä, H. & Pirinen, P. (2013a). Corrosion of reinforcement in existing concrete facades. In V. P. de Freitas & J. M. P. Q. Delgado (Eds.) *Durability of building materials and components, Building pathology and rehabilitation 3* (pp. 253–274). Berlin: Springer.

Lahdensivu, J., Mäkelä, H. & Pirinen, P. (2013b). Durability properties and deterioration of concrete balconies of inadequate frost resistance. *International Journal of Sustainable Building Technology and Urban Development, 4,* 160–169.

Laine, A. (1993). *Arava, asuntohallitus ja asuntopolitiikka 1949–1993* [Arava, national housing board and housing politics 1949–1993] Helsinki: Asuntohallituksen tutkimus- ja suunnitteluosasto.

Lankinen, M. (1998). *Lähiöt muuttuvat ja erilaistuvat: 36 lähiön tilastollinen seuranta 1980–95* [Large housing estates are changing and differentiating: statistical follow-up of 36 neighbourhoods in 1980–95] (Suomen ympäristö 187). Helsinki: Edita & Ympäristöministeriö, Alueidenkäytön osasto.

Lawrence, R.J. (1994). Type as analytical tool: Reinterpretation and application. In K. A. Frank & L. H. Schneekloth (Eds.), *Ordering space: Types in Architecture and Design* (pp. 271–287). New York: Van Nostrand Reinhold.

Lehtinen, E., Nippala, E., Jaakkonen, L. & Nuuttila, H. (2005). *Asuinrakennukset vuoteen 2025: Uudistuotannon ja perusparantamisen tarve* [Residential buildings to the year 2050: the need for new building and fundamental improvement]. Helsinki: VTT Rakennus- ja yhdyskuntatekniikka.

Linne, S. (2012). *Ulkovaipan lämpötalouteen vaikuttavat korjaustoimet käytännössä* [Repair measures affecting the thermal economy of the building envelope in practice]. Tampere: Tampereen teknillinen yliopisto.

Madrazo, L. (1995). *The concept of type in architecture: An inquiry into the nature of architectural form* (Ph.D. Dissertation ETH No. 11115). Zürich: Eidgenössisshe Technische Hochschule.

Mashadi, A. (2012). The architectural and typological properties of plans in design of historical monuments in Arak from Qajar period. *Life Science Journal, 9,* 5929–5935.

Maununaho, K. (2012, June) *Meanings and reflections of multiculturalism in planning and design.* Paper presented at the conference Planning with Difference: Challenges, Perspectives and Practices, Tromsø, Norway.

Moneo, R. (1978). On typology. *Oppositions*, 13, 23–45.

Muraj, I., Veršic, Z. & Štulhofer, A. (2014, June). *Energy Efficient Solutions for Multi-apartment Buildings in Croatia.* Paper presented at the 1st South East European Conference on Sustainable Development of Energy, Water and Environment Systems — SEE SDEWES, Ohrid, Macedonia.

Mäkiö, E., Malinen, M., Neuvonen, P., Sinkkilä, J., Tuunanen, A.-M. & Saarenpää, J. (1990). *Kerrostalot 1940–1960* [Apartment blocks 1940–1960]. Helsinki: Rakennustieto.

Mäkiö, E., Malinen, M., Neuvonen, P., Vikström, K., Mäenpää, R., Saarenpää, J. & Tähti, E. (1994). *Kerrostalot 1960–1975* [Apartment blocks 1960–1975]. Helsinki: Rakennustieto.

Neuvonen, P. (Ed). (2006). *Kerrostalot 1880–2000: arkkitehtuuri, rakennustekniikka, korjaaminen* [Apartment blocks 1880–2000: architecture, structures, renovation]. Helsinki: Rakennustieto.

Neuvonen, P., Mäkiö, E. & Malinen, M. (2002). *Kerrostalot 1880–1940* [Apartment blocks 1880–1940]. Helsinki: Rakennustieto.

Official Statistics of Finland (OSF). (2007). *Dwelling completions: number, floor area and number of rooms, 1966–2003* [Data Set]. Retrieved July 25, 2014, from http://www.stat.fi/tup/rakas/demo_10ashuon.xls

Official Statistics of Finland (OSF). (2013). *Dwellings by type of building, occupancy and year of construction 31.12.2013* [Data Set]. Retrieved July 24, 2014, from http://193.166.171.75/Database/StatFin/asu/asas/asas_en.asp

Pärnänen, M., Vaarna, S. & Kukkonen, H. (1994). *Saneerattavan kerrostalon mahdollisuuksia* [Renovation possibilities of an apartment building]. Helsinki: Teknillinen korkeakoulu.

Rantala, E. (Ed.). (2008). *Talotekniikan reititysohje - modulaarinen installaatiotekniikka* [Routing instruction for building services - modular installation technology] (RIL 239-2008). Helsinki: Suomen Rakennusinsinöörien Liitto RIL.

Rantala, E. (Ed.). (2009). *Asuinkerrostalojen linjasaneeraus - hankeprosessi ja tekniset ratkaisut 60- ja 70-lukujen kerrostaloissa* [Plumbing renovations in apartment blocks - the process and technical solutions in 60s and 70s apartment buildings] (RIL 252-2009). Helsinki: Suomen Rakennusinsinöörien Liitto RIL.

Roth, R. & Hashimshony, R. (1988). Algorithms in graph theory and their use of solving problems in architectural design. *Computer-aided design*, 20, 373–381. doi: 10.1016/0010-4485(88)90214-X

RT 930.10. (1965). *Asuminen, yleisten asuntokohtaisten tekijöiden tilantarve, kaaviot 1:100.* [Housing, space requirements for furniture]. Helsinki: Suomen Arkkitehtiliitto, Standardoimislaitos.

RT 930.20. (1974). *Asuminen, ruokatalous, toimintojen tilantarve.* [Housing, space requirements for cooking]. Helsinki: Rakennustietosäätiö.

RT 930.30. (1974). *Asuminen, ruokailu, toimintojen tilantarve.* [Housing, space requirements for dining]. Helsinki: Rakennustietosäätiö.

RT 930.40. (1974). *Asuminen, tekstiilien hoito, toimintojen tilantarve.* [Housing, space requirements for textile care]. Helsinki: Rakennustietosäätiö.

RT 930.50. (1974). *Asuminen, henkilökohtainen hygienia, toimintojen tilantarve.* [Housing, space requirements for personal hygiene]. Helsinki: Rakennustietosäätiö.

RT 935.50. (1966). *Asuminen, makuuhuoneiden pinta-alan tarve.* [Housing, area requirements for bedrooms]. Helsinki: Rakennustietosäätiö.

RT 936.50. (1965). *Asunnon WC- ja peseytymistilat, tilantarve ja huonesovellutuksia 1:50.* [Housing, WCs and bathrooms, space requirements and applications]. Helsinki: Suomen Arkkitehtiliitto, Standardoimislaitos.

Sorri, L. (2006). *1950–1980-lukujen asuinkerrostalojen soveltuvuus senioriasumiseen* [Suitability of blocks of flats from 1950s to 1980s for senior housing] (Arkkitehtuurin osaston julkaisu A 35). Oulu: Oulun yliopisto.

Statistics Finland. (2014). *Construction and Housing: Yearbook 2013.* 2nd rev. ed. Helsinki: Statistics Finland

Steadman, P. (1983). *Architectural morphology: An introduction to the geometry of building plans.* London: Pion.

Strauss, A. & Corbin, J. (1990). *Basics of qualitative research: Grounded theory procedures and techniques*. Newbury Park: Sage.

Theodoridou, I., Papadopoulos, A. M. & Hegger, M. (2011). A typological classification of the Greek residential building stock. *Energy and Buildings, 43*, 2779–2787. doi:10.1016/j.enbuild.2011.06.036

Thomsen, A. & van der Flier, K. (2011). Conceptual model for obsolescence. *Building Research and Information, 39*, 352–362. doi: 10.1080/09613218.2011.576328

Uotila, U. (2012). *Korjaustoimien vaikutukset lähiökerrostalon todelliseen energiankulutukseen* [The effects of energy renovation measures on apartment buildings]. Tampere: Tampere University of Technology. Retrieved from http://URN.fi/URN:NBN:fi:tty-201208301259

Valtion asuntorahasto. (1999). *Aravaa kautta aikojen* [Arava through the ages]. Helsinki: Valtion asuntorahasto.

Van der Voordt, T. J. M., Vrielink, D. & van Wegen, H. B. R. (1997). Comparative floorplan-analysis in programming and architectural design. *Design Studies, 18*, 67–88.

Vissilia, A-M. (2009). Evaluation of a sustainable Greek vernacular settlement and its landscape: Architectural typology and building physics. *Building and environment, 44*, 1095–1106. doi: 10.1016/j.buildenv.2008.05.026