

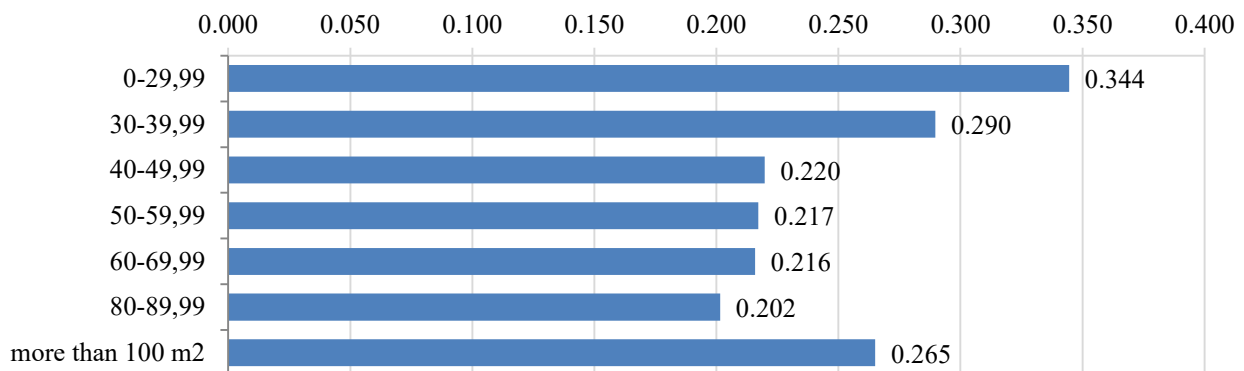




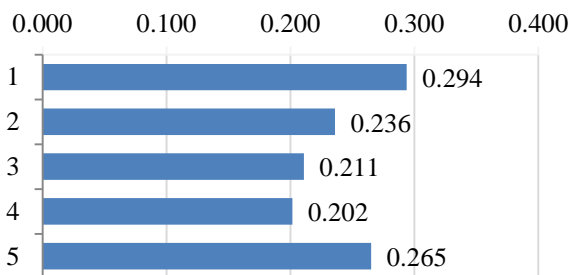


The flats examined had different usable space as well as the number of rooms. Therefore, it was decided to check whether these parameters affect the overall number of defects. The results are presented in Figures 4 and 5. Base on the graphs, the number of defects per m2

increases with decrease in size (square meters) and type (decrease in number of rooms) of an apartment. There was very small sample size for five-room apartment with size over 100 m<sup>2</sup>, therefore the results for this range may be disproportionate compared to the other groups.



**Fig. 4.** Average number of defects per m<sup>2</sup> of flat (division of flats by their area)

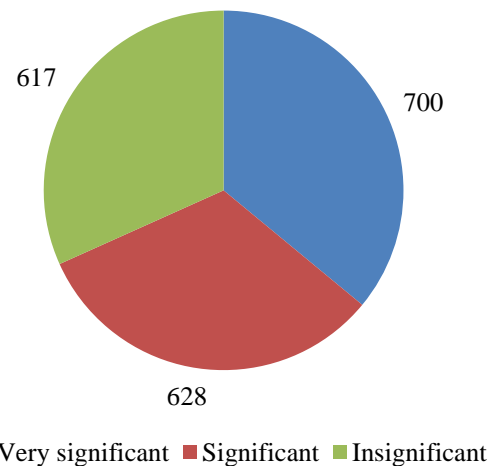


**Fig. 5.** Average number of defects per m<sup>2</sup> of flat (division of flats by the number of rooms in the apartment)

For the purpose of developing a procedure and a subsequent mathematical model supporting acceptance decisions, the defects were divided into three basic groups on the grounds of their significance (Fig. 6).

Defects of little significance can be defined as those requiring a slight and non-intrusive interference in the object of acceptance. Such defects require cleaning, removing the material allowance or a slight chipping of the element, and the most common ones include: scratched window sill (152), scratched balustrade (89), dirty door handle (74) and painting correction (66).

Medium-sized defects require a greater amount of work and material to remove them, but they do not constitute a strong obstacle to handing over the flat. These include: scratched glass (218), cavities for filling in walls and ceilings (135), façade painting correction (83) and lack of silicone in flashing elements and plinths (63). Very significant defects denote those that prevent the handover the keys to the flat owner, due to the need for the contractor to carry out complex works in terms of labor consumption and technology for their implementation or those that prevent the operation of the apartment, for example: plaster cracks (249), no straight angle between walls (181) and cracked screed (120).



**Fig. 6.** Number of defects grouped according to their severity

In the building analysed, a total of 1945 defects were detected, where about 30% of them can be classified as very significant defects, thus requiring repair by the contractor. Two apartments were not accepted by the supervision inspector. On average, there were 11.32 defects per one flat and 0.23 defects per m<sup>2</sup> of flat area.

### 3 Flat acceptance procedure

The contract between the developer and the buyer of the flat is regulated by the Act on protecting the rights of purchasers of apartments and houses [19]. Art. 27 sec. 1 discusses the need to accept apartments: the article states that the handover of ownership of the premises to the buyer must be preceded by the acceptance of the apartment, which is preceded by the notice of completion of the construction, with no objection from the competent authority or based on the decision on the use permit. The acceptance is made in the presence of the buyer. A handover inspection report is made in which the owner can notify defects of the apartment. Within 14 days of

signing the report, the development company is obliged to provide the buyer with a declaration of recognition or refusal to recognize the defects, along with the causes. The developer is obliged to remove the defects recognized in the apartment within 30 days of signing the apartment handover inspection report. If the developer, despite due diligence, does not remove the defect in the above-mentioned period, an appropriate, different date for removal of the defects along with the justification for the delay may be indicated [19]. In the case of defects not settled in the property development act [19], the provisions of the Civil Code [3] shall apply. According to art. 22 para. 1 point 6 [19], the developer contract should contain *the determination of the area and layout of the rooms, as well as the scope and standard of finishing works to be performed by the developer*: the article mentioned regulates the developer's obligations towards the scope of finishing works as well as their standard.

Fig. 7 presents the procedure for the handover of apartments. **The procedure has the following elements:**

- After obtaining a permit for the use of a residential building, the apartment is accepted by the supervision inspector.
- When inspecting the flat, the inspector indicates the defects; if none have been detected, the inspector issues a decision to hand over the flat to the owner.
- If the inspector's acceptance showed insignificant defects, the inspector issues a positive decision and hands over the flat to the owner. When very significant defects are found, the inspector issues a negative decision. In the case of significant defects, the inspector makes the decision about the handover on the basis of the inspection of the flat.
- After repairing the indicated defects, the inspector repeats the handover of the flat, and records it in the handover inspection report.
- Then the apartment acceptance is done by the owner. The owner indicates defects during the handover. If none has been found, the apartment is accepted.
- If the acceptance by the owner has shown insignificant defects, the apartment is handed over, except that the developer agrees to repair the defects indicated within the prescribed period. When very significant defects have been detected, the owner does not accept the apartment: the flat is directed to a new handover, repair of the defects, etc. In the case of significant defects, the owner decides whether to accept the apartment with the repair of the defects within the deadline specified in the handover inspection report, or not to accept the flat for the supervision inspector to hand it over again.

The procedure that has been developed is based on Polish regulations [19] and is in full compliance with them. It should be noted that the legal regulations only set the general framework for flat acceptance so investors apply their own practices. Because of lack of full and detail procedure the authors took attempt to develop one. In the proposed procedure, the authors recommend to group the defects, as well as the related course of action. The procedure has been enriched with many years of experience of authors dealing with the acceptance of apartments in development investments as well as

real estate development companies. Following the procedure and taking into account severity of housing defects during the handover process, may shorten time to receive a flat and drive a decrease in the cost of repairing defects, what will be analyzed in subsequent publications.

The authors' further scientific considerations will include the valuation of defects found in the building.

The research objective set should lead to the development of a decision-making tool used by the supervision inspector to decide on the acceptance of the flat due to the cost of repairing defects detected during the reception of the apartment by the inspector and the owner.

## 4 Conclusions

Each construction differs from all other buildings, which is the reason for the existence of various defects in the works of various industries in each building constructed (even by the same contractor). It is always necessary to systematically control the course of preparation and implementation of the development venture, that is, from the design assumptions, to the final acceptance of the buyer's flat.

The article presents the most frequent housing defects, so involved parties may pay particular attention to them and finally increase number of defects detected during handover process.

During the analysed handovers, it was found that the most frequently occurring defects include: cracks in walls and ceilings, scratched glass, lack of right angles between walls and scratched window sills. There was an average of 11.32 defects per apartment and 0.23 defects per square meter of apartments. In the building analysed, 1945 defects were found, while very significant, significant and insignificant defects had a similar quantitative share.

The investors apply their own procedures of flat acceptance, because the legal regulations only set the general framework for flat acceptance. There is a lack of full and detail procedure so the authors took attempt to develop one. Following the procedure may drive a decrease in the cost of repairing defects and shorten time to receive a flat, what will be analyzed in subsequent publications.

Further scientific considerations of the authors will concern the valuation of defects found in the building by both the inspector and the buyer of the apartment.

The authors are planning to create a decision-making tool that can be used to make a decision by the supervision inspector about the acceptance of the flat according to the cost of the repair of the defects found during the reception of the dwelling by the inspector and the owner. The tool will be based on the procedure for the acceptance of apartments presented in the paper.

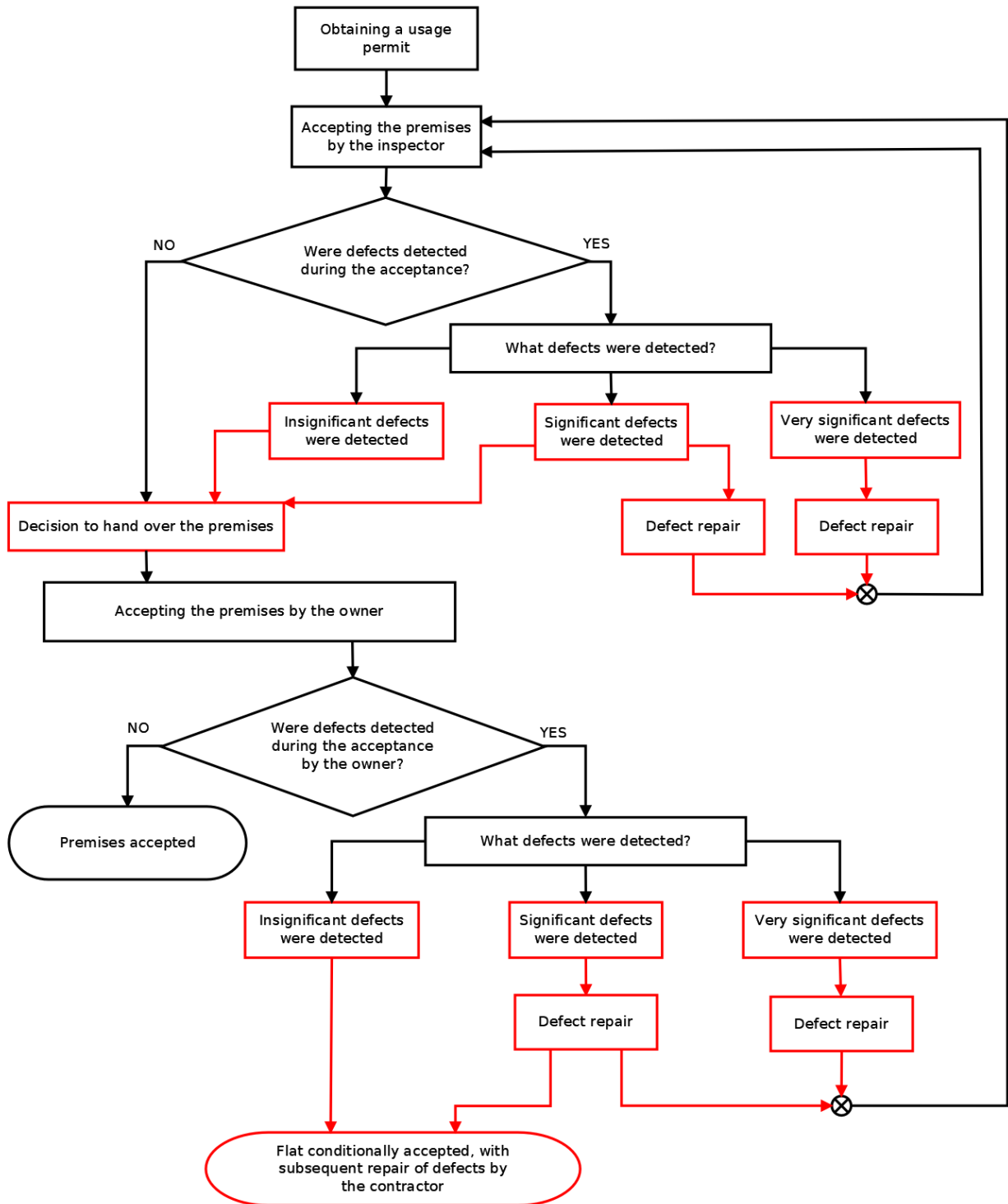


Fig. 7. Flat acceptance procedure

## References

1. E. Plebankiewicz, M. Juszczak, J. Malara. *Prz. Nauk.*, **65**, 271-278 (2014)
2. G. Chrabczyński, A. Heine, Definicja wady budowlanej. Retrieved from : [http://www.inzynierbudownictwa.pl/biznes.prawo.art.ykul.definicja\\_wady\\_budowlanej,28](http://www.inzynierbudownictwa.pl/biznes.prawo.art.ykul.definicja_wady_budowlanej,28) (2006)
3. Dz.U.2017.0.459 - Ustawa z dnia 23 kwietnia 1964 r. - Kodeks cywilny
4. N. Ahzahar, N. A. Karim, S. H. Hassan, J. Eman. *Procedia Eng.*, **20**, 249-255 (2011)
5. N. O. B. Nurul, O. M. Md Azree. *EJTD*, **3**, 4-17 (2014)
6. I. Ismail, A. I. Che-Ani, M. Razak, N. Mohd Tawil, S. Johar. *J Teknol*, **75**, 83-88 (2015)
7. F. E. Rotimi, J. Tookey, J. O. Rotimi. *Buildings*, **5**, 39-55 (2015)
8. F. E. Rotimi, *An evaluative framework for defects in new residential buildings: the New Zealand case*. (AUT, Auckland, 2013)
9. A. M. Ojo, O. O. Ijatuyi. *IJCECEM*, **2**, 16-30 (2014)
10. D. B. Hammad, N. Shafiq, M. F. Nuruddin. *MATEC web. conf.*, **15**, 1-7 (2014)
11. J. M. M. Fernandez, C. P. González, V. Cabal, J. V. Balsera. *Rev. Constr.*, **15**, 106-114 (2016)
12. S. Dubas, P. Nowotarski, R. Milwicz. *Mat. Bud.*, **6/2016**, 166-167 (2016)
13. R. Oswald, R. Abel, *Wady i usterki w budynkach*. (Instalator Polski, Warszawa, 2000)
14. J. Czupajłło, *Usterki w pracach budowlanych i wykończeniowych*. (PWN, Warszawa, 2017)
15. K. Zima, *Analiza deweloperskich przedsięwzięć budowlanych z zastosowaniem logiki rozmytej*. Praca doktorska. (PK, Kraków, 2007)
16. M. Połński, *Proces inwestycyjny i eksploatacja obiektów budowlanych*. (Wyd. SGGW, Warszawa, 2008)
17. E. Plebankiewicz, A. Dziadosz. *Prz. Bud.*, **5/2006**, 45-49 (2006)
18. R. Kozik, K. Zima. *Prob. Rozw. Miast*, **4/2013**, 41-52 (2013)
19. Dz. U. 2011 nr 232 poz. 1377 - Ustawa z dnia 16 września 2011 r. o ochronie praw nabywcy lokalu mieszkalnego lub domu jednorodzinnego.