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# Higher Incidence Pathologies in Installations of Solar Energy, Gas, Cooling, Heating and Ventilation

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## 1 General vision

For Behfar, Yuill and Yu (2017), the detection and diagnosis of faults in buildings' installation systems (especially when those faults convert into pathology problems) is of interest given that they allow the reduction of consumptions and operating costs, thus being a useful work tool for all technicians (engineers as well as architects).

One of the main limitations for the ample and in-depth knowledge of problems in installations is that a part of the reviewed literature has relied on observation processes or on surveys more or less focused on buildings of a specific developer or builder. Moreover, the lower number of problems existing therein in relation to other units more prone to pathologies (such as roofs, facades and structures) lead to them being less known.

The purpose of this research is to identify the most important types of anomalies in these types of installations, as well as their recurrence, based on judicial complaints made across all of Spain by building owners.

This research analysed the data corresponding to the policies dated 2014-2016 of the civil responsibility insurance of Spanish technical architects and building engineers (Musaat, 2014-2016) that saw complaints by owners related to construction problems (Serjuteca, 2014-2016). This data was sourced from the Musaat Foundation's study "National statistical analysis on construction anomalies" (Carretero-Ayuso and Moreno-Cansado, 2016), that aimed to identify the most frequent anomalies in the Spanish construction sector.

When a building user experiences problems in the construction, and the developer and builder do not solve them, users often resort to the judicial route. At this point, they also file complaints against the technicians that participated in the construction process: the designer and construction managers. This is done mainly because these technicians should be covered by civil responsibility insurance, which, in turn, is not required in Spain for developer and builder companies.

All the complaints filed in the country were analysed and protocolised, with 183 cases being found (number of times an anomaly was counted) related to the installations being study: 'Solar Energy' (I1), 'Gas' (I2), 'Cooling' (I3), 'Heating' (I4) and 'Ventilation' (I5).

The classes were classified into 4 groups, each representing a different type of anomaly that was the object of a complaint by owners, according to the conclusions of the relevant technical reports. The types of anomalies are: 'Fissures in the cladding' (A1), 'Deficient ventilation (A2), 'Leaks or humidities' (A3) and 'Dysfunctions' (A4).

The pathological origins leading to these anomalies were identified and catalogued into 4 types: 'Inadequate tail-ends' (OP1), 'Omission of elements' (OP2), 'Irregularities and deficiencies' (OP3), and 'Various' (OP4).

The values obtained in the five installations were very different from one another. As shown in *Figure 1*, ventilation (I5=42%) accounts for the greatest percentage, followed by heating (I4=32%). In last place are solar energy installations (I1=2%).

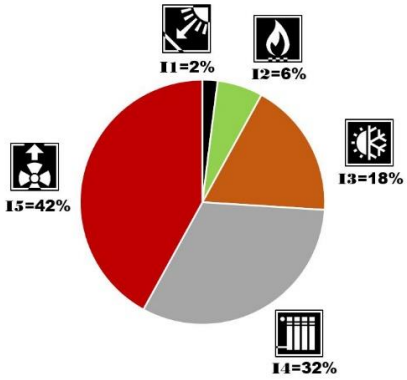


**Figure 1**. Percentages of cases existing in each installation.

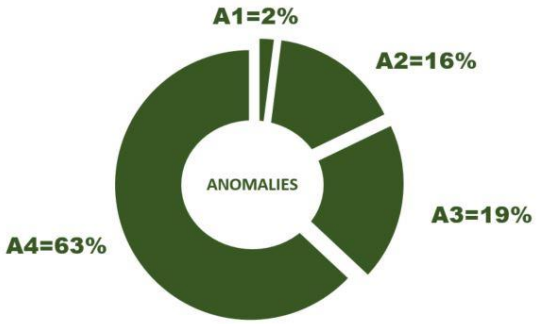


**Figure 2.** General percentages of the types of anomalies found in the research.

As indicated above, each of the 4 types of anomalies that were the object of complaints were analysed. The one with the greatest prevalence was 'Dysfunctions' (A4=64%), a term that has grouped within it a series of anomalous and poorly functioning processes. As shown in *Figure 2*, 'Leaks or humidities' (A3=19%) are placed second.

The pathological origin (cause) with the greatest prevalence is OP4, with 35%, followed by OP3 with 34%. If the origins are broken down for each of the five installations, the following results are obtained:

-Solar energy (I1) = OP3(100%)
-Gas (I2) = OP1(45%) + OP3(36%) + OP4(18%)
-Cooling (I3) = OP1(16%) + OP2(13%) + OP3(31%) + OP4(41%)
-Heating (I4) = OP1(8%) + OP2(24%) + OP3(39%) + OP4(29%)
-Ventilation (I5) = OP1(8%) + OP2(25%) + OP3(27%) + OP4(40%)

It can be seen that the installations I3, I4, and I5 have 4 pathological origins each. In turn, I2 has 3 types of origins, and I1 has only 1 type.

Lastly, it was shown that the expert technical reports used as a basis for owners to be able to file their complaints were a very helpful procedure to determine the installations in which anomalies occur the most.

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