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ARTICLE

Technological obstruction as residential vulnerability. Asbestos in Chilean housing blocks

La obduración tecnológica como vulnerabilidad residencial. El asbesto en bloques de vivienda chilenos.

Jorge Vergara Vidal [1]
Metropolitan Technological University, Chile

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Abstract

The critical observation of the technological frameworks that organize the production of material environments is key to elaborate inputs that nourish the public debate on their governance and on the ways used to evaluate their relationship with them. This text addresses the case of the presence of asbestos in Chilean residential buildings because it enunciates how relationships with the material acquire contingency when they move from a framework that values a materiality as innocuous, to another that gives it an opposite value. Using a mixed methodological approach, which considered both the analysis of databases from sources

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[1] Contact: Jorge Vergara Vidal j.vergara@utem.cl

such as INE and MINVU, and the analysis of documents and interviews, this paper describes the milestones that articulate the residential vulnerability associated with asbestos, describing its modes of valuation, its extent and the actions taken for its control in the case of social housing blocks in Chile. Based on this evidence, the forms of resistance to the solution that this vulnerability has developed due to its massiveness, the cost associated with its removal and due to the property regime of the cases where it is developed are discussed. The paper concludes that what has been observed is that material vulnerabilities also have a residential and urban scale and expression, and that in them, both the State and the communities are key to overcome the different forms of obduration they present and to manage material risks in the cities.

Resumen

La observación critica de los marcos tecnológicos que organizan la producción de los entornos materiales es clave para elaborar insumos que nutran el debate público sobre su gobernanza y sobre los modos empleados para evaluar su relación con ellos. El presente texto aborda el caso de la presencia de asbesto en las edificaciones residenciales chilenas enunciando cómo las relaciones con lo material adquieren contingencia cuando se desplazan desde un marco que valora como inocua una materialidad, hacia otro que le otorga un valor contrario. Utilizando un enfoque metodológico mixto que consideró tanto el análisis de bases de datos de fuentes del Instituto Nacional de Estadísticas (INE) y del Ministerio de Vivienda y Urbanismo (MINVU) como el análisis de documentos y entrevistas, este trabajo describe los hitos que articulan la vulnerabilidad residencial asociada al asbesto, describiendo sus modos de valoración, su extensión y las acciones tomadas para su control en el caso de los bloques de vivienda de interés social en Chile. Con base en esa evidencia se discuten las formas de resistencia a la solución que esta vulnerabilidad ha desarrollado debido a su masividad, al costo asociado a su retiro y al régimen de propiedad de los casos donde se desarrolla. El trabajo concluye que lo observado es útil para tomar en cuenta que las vulnerabilidades materiales también tienen una escala y expresión residencial y urbana, y que, en ellas, tanto el Estado como las comunidades son claves para vencer las diferentes formas de obduración que presentan y gestionarlos riesgos materiales en las ciudades.

Palabras Claves: *Vulnerabilidad residencial; materialidad; asbesto; obduración tecnológica; bloques de vivienda de interés social*

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Introduction

The extensive literature on social vulnerabilities, particularly in urban contexts, encompasses debates focused on factors that either favor or amplify the incapacity of spaces, groups, or individuals to cope with climate, economic, or social contingencies. In the literature concerning Chile, vulnerability is often associated with an administrative and/or geographical space whose infrastructures may be unable to withstand the effects of climate change (Welz and Krellenberg, 2016; Sandoval et al., 2018; Faria-dos-Santos et al., 2022). It can also be linked to groups of people unable to address changes affecting their residential spaces, constituting a form of urban exclusion based on income inequality, predominantly understood as residential vulnerability (Marín et al., 2017; García-Hernández and Ginés-De la Nuez, 2020). This work delves into the latter aspect, exploring a form of urban and residential vulnerability related not to the precariousness of housing materials but to the health risk associated with the use of some of these materials, particularly focusing on the use of asbestos-cement in social housing in Chile.

The hypothesis of the text is that the use of asbestos in social housing is carried out within a specific sociotechnical framework that justifies it. Once its social validity and material utility are depleted, it becomes recognized as toxic. This recognition expresses a certain resistance or obduracy to its replacement, becoming a form of residential vulnerability for people exposed to it. Individuals cannot easily detect or remove asbestos from their homes. The goal of the study is to explore technological resistance or obduracy in materials and regimes as a form of residential and urban vulnerability, considering it as a variable when organizing these regimes and designing long-lasting objects, such as social housing and associated material policies.

Using a mixed methodological approach, drawing on documentary sources, data from the INE (National Institute of Statistics) Building Survey (1990–2001), and the National Condominium Registry conducted by MINVU (Ministry of Housing and Urbanism) in 2014, the following text describes how managing the vulnerability involving the presence of asbestos in social housing encounters elements of resistance due to its widespread nature. Additionally, it examines how public policy contributes to this management by creating conditions for repair resources to be channeled under a new collective ownership regime for buildings (social condominiums), different from the individual property regime of homes.

Methodology

As mentioned, the methodological approach considered both the analysis of INE and MINVU databases and the analysis of documents and interviews obtained within a sociological study on social housing blocks in Chile. In this context, references to the presence of asbestos in buildings were observed unsystematically in technical and practice reports, plans, quantities, and statistics. The analysis had limitations, including the partial availability of documentation and the non-continuous condition of the measurements of the phenomenon. The obtained result is presented below.

Theoretical Framework

The theoretical framework of this work draws on literature that addresses the material and technological elements affecting the safety of built environments and the literature discussing the resistance or obduracy of these vulnerabilities as a social phenomenon. The former includes literature that has documented situations where the health of building occupants or residents is affected by its technological or material components. The so-called Sick Building Syndrome (SBS) and Building-Related Illness (BRI) refer to effects and symptoms associated with the use of air conditioning, aerosols, hygiene chemicals, or paints. They also relate to the exposure of materials such as various forms of asbestos in components like partitions, slabs, and roofs, or in installations like water pipes or drains (Environmental Protection Agency, 1991). This results in diseases that, at best, directly impact absenteeism and reduce people's productivity (Instituto Nacional de Seguridad e Higiene en el Trabajo, 1991a; 1991b; Niemelä et al., 2006; Joshi, 2008) and, at worst, lead to prolonged or terminal illnesses (Boldú and Pascal, 2005).

The World Health Organization (WHO) has warned and worked on both situations, identifying the components and installations that generate such vulnerabilities and promoting a preventive approach (OMS, 1982; 1986; 1987). However, as with the massive use of materials, the scale of the problem makes it difficult for individuals, families, or communities to independently address the risks that the presence implies (Laumbach et al., 2015). This creates a type of technological vulnerability that can be described as obduracy, a resistance rooted in objects and built environments to change or adapt to certain external contingencies (Hommels et al., 2014). In particular, Anique Hommels (2000; 2017; 2020) uses this term to characterize difficulties in changing and adapting technical, architectural, and urban objects in relation to unforeseen contingencies they face.

Given this framework, this work addresses the presence of asbestos in social housing blocks in Chile as a type of residential and urban vulnerability. It presents a form of obduracy based not so much on the technological mode of housing but on its massiveness, repair costs, and the ownership regime of its cases. This configuration creates a scenario where the problem is too large to be solved by individuals or groups alone, and where the State and communities are necessary to alter the technological framework of society and address the problems derived from it.

Housing Blocks of Social Interest in Chile and a Technological Framework that Included Asbestos

Housing blocks are a type of architecture that began to be used in Chile around 1936. They represent a form of collective housing promoted both by the Social Security Fund and by companies interested in having their workforce and administrative staff close to their operations. The technological framework for this type of architecture begins to be outlined in the Cheap Housing Law (Ministry of Hygiene, Assistance, Social Provision, and Labor, 1925). This law designates them as single-body buildings, earthquake-resistant, and fireproof. This implies a multi-story construction that includes concrete, steel, and brick, and involves a regime of co-ownership. The initial drafts of this framework start with the introduction of modern ideas about collective housing and materialize in the first collective buildings of single-body extended concrete housing, parquet floors, and clay tile roofs, dedicated to the housing of working and middle-class sectors (Pérez, 2017). Subsequently, more nuclear models will follow the formula of medium-rise construction, concrete framework, and brick walls.

The consolidation of this type of building typology occurred around 1943 when, within the framework of the developmental modernization of Chilean cities, the first large housing complexes were planned. The state-owned Popular Housing Fund experimented with its first serialized and replicable models in these complexes. In their design, the technical department of the fund used two standardized house models: a paired one-story, type 81, which was laterally and vertically added in blocks of three stories, and a second paired two-story house model, type 125, which was vertically added, for-

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ming four-story blocks. The premise of these models was their low construction cost, so while they maintained the structure and concrete and brick walls, they used asbestos fiber-cement in the roofs, which was cheaper than tiles and was believed to be harmless to human health.

The models of houses and multi-story blocks that followed the 81 and 125 Duplex models replicated their material formula. This trend continued with the designs by the Housing Corporation (CORVI) from 1953 to 1975, which deepened the original technological framework through the rationalization of materials. This resulted in designs that sought to be progressively cheaper, more nuclear, and extended the use of asbestos variants to walls and floors, in addition to roofs. Including the 81 and 125 Duplex collectives, 26 types of multi-story collective housing blocks used asbestos in roofs, walls, and floors, at least in theory, as confirmed by various documents and plans referring to the materials and quantities to be used in each case (Vergara et al., 2022).

The adaptation and use of the designs of CORVI's 3101 and 3502 blocks by private construction companies, starting in 1976, extended the technological framework used in developmentalism into the neoliberal period. In the process, the stairs and solid material circulation were sacrificed. The neoliberal framework, focused on seeking greater business profits, intensified the use of asbestos, despite news about its toxicity already being widespread, and the country itself had signed an agreement with the International Labour Organization (ILO) in 1986 to restrict the use and manufacture of asbestos-based products.

Nevertheless, by the early 1990s, asbestos-cement was considered both a conventional material (Hernández, 1986; Sepúlveda and Carrasco, 1991; Moyano, 1994) and a suitable technology for the construction of social interest housing (Sepúlveda et al., 1991; Zaccarelli, 1993). Its use was also widespread on roofs of schools, markets, and homes, as well as sunshades for the protection of loggias, terraces, and staircases, among others (Architecture Urbanism Construction Art, 2020). The Belgian-owned company producing it, Pizarreño, deployed strong lobbying efforts with the Concertación governments to prevent its prohibition, even at the expense of the health of its own workers (San Juan and Muñoz, 2013).

Finally, in the year 2000, Decree No. 656 of the Ministry of Health was enacted, prohibiting its manufacture, considering the evidence of its long-term effects. In this regard, data from the Building Survey (1990–2001) compiled by the National Statistics

Institute (INE) and providing information on authorized buildings between 1990 and 2001 indicate that during that period, 35.9% of the roof surfaces of buildings contained Corrugated Asbestos Cement (32.7%), Asbestos Cement Shingles (2.3%), and Asbestos Cement in other forms (0.9%). Eighty-five percent of this materiality is found on roofs of 1 and 2-story buildings, while 14.8% is recorded in buildings between 3 and 4 stories. However, despite this clear distribution, this materiality is present in all categories of buildings according to their height (Figure 1)

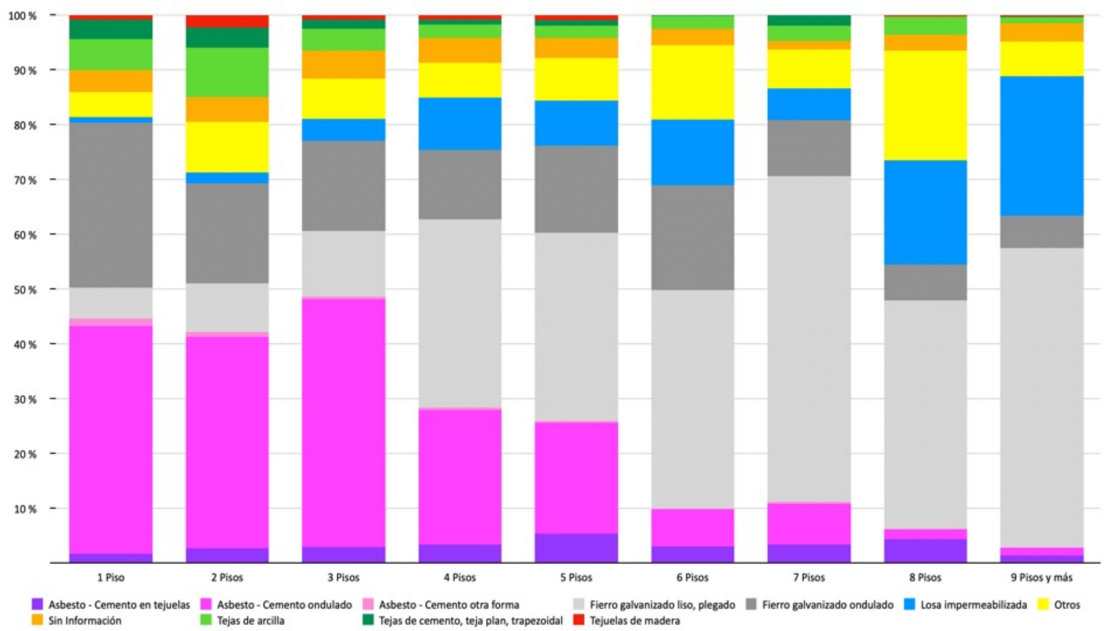

Figure 1. Percentage of Asbestos Cement in Building Roofs in Chile 1990-2001.
Source: Building Survey, INE 1990-2001

Later, data collected by the National Registry of Social Condominiums (MINVU, 2015) indicated that by the year 2000, 10,220 units of social interest housing blocks had some type of asbestos presence, representing 51% of what was built to that date (Figure 2). When considering data until 2015, the number of block units with asbestos presence in Social Condominiums rises to 10,486 buildings, which corresponds to 48% of the blocks constructed since the beginning of the use of this typology.

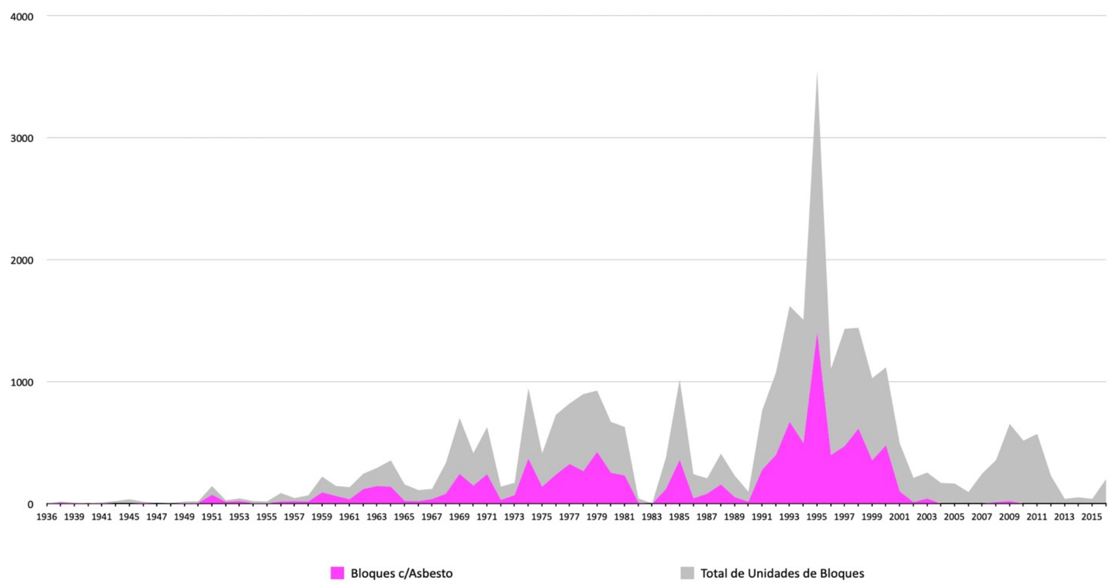

Figure 2. Number of units of blocks with asbestos presence in sets of Social Condominiums surveyed by MINVU 1936–2015.
Source: Own elaboration based on the National Registry of Social Condominiums, MINVU, 2015

As seen in Figure 2, the period with the highest number of units of blocks with asbestos presence was between 1990 and 2000 (5,560 units), followed by the period between 1976 and 1989 (2,528), and then the period between 1966 and 1975 (1,354 units). These periods coincide with the operation of different institutional frameworks that articulated the material housing policy. The last period corresponds to the final stage of developmentalism, where the standardization of models and the rationalization of their costs generated a typological model whose design, including material decisions, was in the hands of architecture offices and state Corporations (CORMU and CORVI) through public or internal competitions.

The other two, more recent periods correspond to the neoliberal adaptation of the technical values of the immediately preceding standardization and rationalization model. In these consecutive periods, one during the civic-military dictatorship and the other during the first ten years of the democratic recovery, construction companies took on both the design and construction decisions of block units, adapting the lower-cost materiality of the developmentalist model and extending the use of asbestos. As observed in Figure 3, the highest volumes of block units with asbestos presence are attributed to the MINVU Basic Housing Program, initiated in 1982, but there is no information about the entities that constructed them.

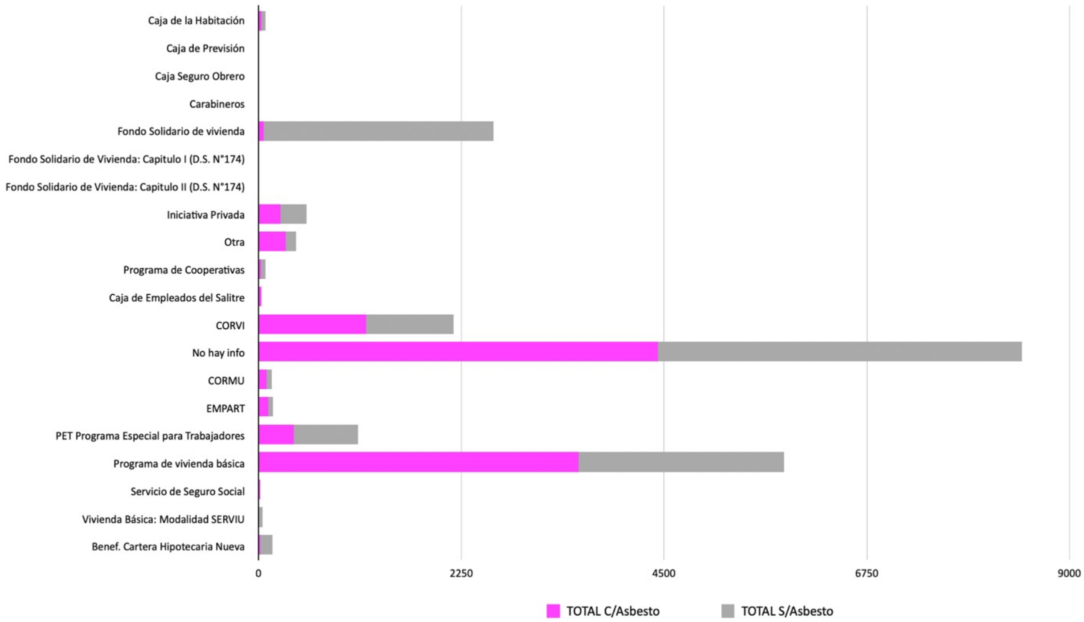

Figure 3. Number of units of blocks with and without asbestos presence according to institutions responsible for their production 1936–2015.
Source: Own elaboration based on the National Registry of Social Condominiums (MINVU, 2015).

The material obduracy and the emergence of residential vulnerability

The case of asbestos presence in social housing blocks illustrates how relationships with materiality become increasingly contingent when they shift from a framework that values a material as harmless to another that assigns it a contrary value, as happened around the year 2000. This shift was accompanied by a change in the statistical measurement instrument, as the Single Building Statistics Form, which does not mention asbestos but includes other types of fiber-cement, replaced the Building Survey.

It also demonstrates that approaches to this type of vulnerability have not solely focused on health or technical aspects but involve other ways of governing the problem. The decision to focus on social housing blocks rather than individual houses is evident, despite data from the INE Building Survey (1990–2001) during the peak production period of social housing units in blocks (1990 to 2001, according to Figure 2), indicating that 85% of asbestos was used in 1- and 2-story houses. This suggests a decision to address only 15% of the affected buildings and not the majority or the whole (Figure 4).

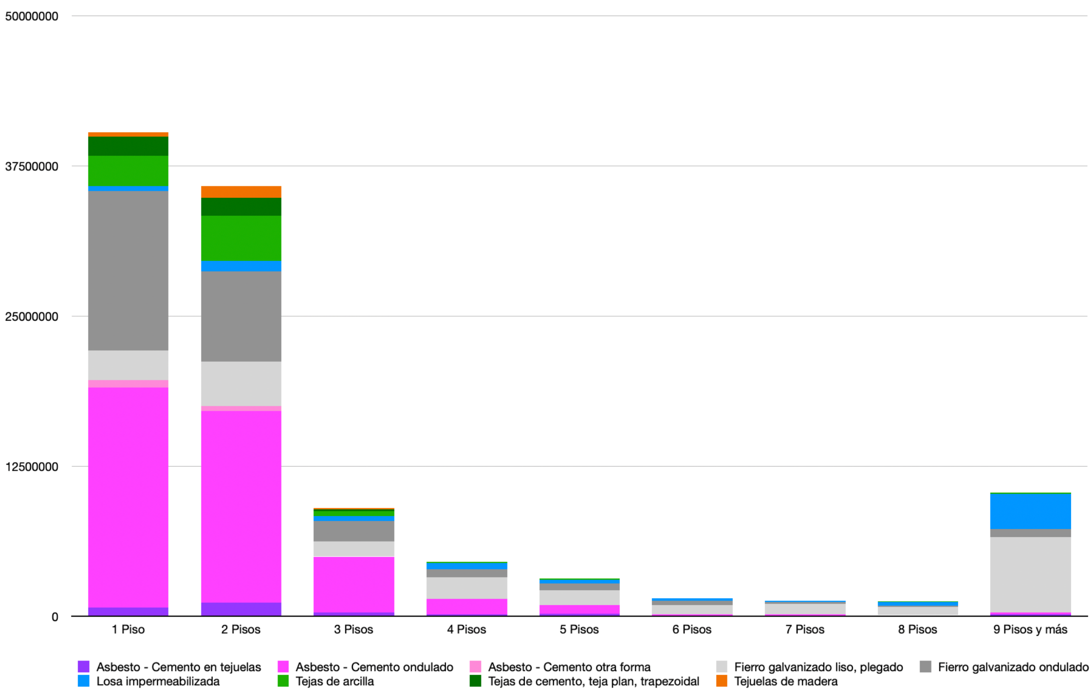

Figure 4: Distribution of Asbestos Cement in Building Roofs in Chile 1990–2001, by Floor Levels. Source: Own elaboration based on the Building Survey, 1990–2001, INE

The explanation for the above is related to the particular technological culture of Chilean society, which frames decisions about objects (of any scale or function) based on their ownership and the lowest cost for the State. The number of houses with asbestos is not only ten times greater than the number of housing blocks, which makes the massiveness of the phenomenon an obstacle to its solution, but it also concerns individual private properties, whether owned by natural or legal persons, which do not meet the profile of beneficiaries of state aid. Therefore, the fact that policies and programs associated with this issue have been developed around the implementation of Law 19,537 on Real Estate Condominiums (2007) helps in a calculated legal and economic focus, leaving aside the population most affected, individual privately-owned houses and their inhabitants.

In particular, the Law on Real Estate Condominiums establishes that all constructions and/or land under the condominium regime are understood as Condominiums. Within these, Social Condominiums are defined as

> *“those constructions or lands subject to the condominium regime, in which, with the aim of facilitating neighborhood administration and organization, it is necessary to define a limit on the number of homes that make up the condominium, not exceeding 150 units per condominium.” (MINVU, 2014, p.21–22)*

Following this direction, the National Registry of Social Condominiums, carried out by the Executive Secretariat of Neighborhood Development, between 2010 and 2013, and updated in 2015, served to dimension the problem using an unprecedented repertoire: the registry of a specific architectural typology, social housing blocks (MINVU, 2014). Its results indicated that 10,486 units of social housing blocks, equivalent to 48% of those built between 1936 and 2015, had asbestos, affecting approximately 180,000 housing units. They also indicated that 266 of these units had been built after 2002, implying that the ban had not had total effects but was limited to units produced between 2002 and 2003, and between 2006 and 2007.

Triggered by this, but avoiding giving an alarming connotation, public policies and programs that implemented asbestos removal were conceived as improvement and repair programs, adapting previous programs to Law 19,537, such as the Participatory Financial Assistance Program in Social Housing Condominiums of 1998 (MINVU, 1998) and the Family Heritage Protection Program of 2006 (MINVU, 2006); or developing new instruments, such as the Social Condominium Improvement Program of 2011 and the Housing Condominium Improvement Program of 2016 (MINVU, 2016), which expressed the objective of “improving the residential habitat quality of families living in social condominiums in the country,” and thereby “contributing to reducing the qualitative urban housing deficit” (MINVU, 2015, p.3).

To these instruments, the Family Heritage Protection Program, Titles II and III of Housing Improvement, and the Neighborhood Set Regeneration Program (PRCH) have been added since 2017, individually or together, to enable the material and aesthetic improvement of block units (Chateau et al., 2020) within a narrative that justifies asbestos removal as an improvement of roofs including the installation of solar panels (Country Agenda, 2022). In fact, none of the aforementioned programs mentions the specific activity they perform, but they are identifiable when referring to the intervention of Technical Assistance Service Providers or TASP, which are technical entities responsible for the specific tasks of mineral removal (Bustos, 2020) (Figure 5).

Figure 5. Advertisements for the application and implementation of programs for the improvement and repair of high-rise housing blocks by MINVU.
Source: Photographs taken by the author and
https://www.facebook.com/MinvuChile/posts/2325683917523682/?locale=es_LA

The above describes three types of obdurations presented by asbestos in residential buildings: its massiveness, which discourages a quick and extensive response that includes all types of buildings where it was implemented; the cost of its removal, which leads to prioritizing the type of buildings with greater social benefits, even if their number is smaller than other typologies; and the alarm caused by its presence, which results in withdrawal policies being slow and concealed within improvement programs. All of this articulates a vulnerability that, when made public with its prohibition, becomes obdurate by resisting quick and individual solutions by people in various ways.

On the contrary, both the exploration of the phenomenon and its intervention require a volume of actions and resources that can only be mobilized by a massive actor such as the State, through MINVU. Furthermore, the difficulties in removing asbestos components from collective buildings have been accompanied by the intention to extend the useful life of these buildings, which necessitates involving the people and communities living in them in the management of these vulnerabilities. Thus, resolving the rigidity of this type of vulnerability requires mobilizing both the State and resident communities, as experienced in the different programs implemented by MINVU (Chateau et al., 2020) (Figure 6).

Figure 6. Collective high-rise residential buildings undergoing improvement and repair works by MINVU, Metropolitan Region, January 2022.
Source: Photographs taken by the author.

Conclusions: Vulnerability, Obduracy, and Community

As observed, the use of asbestos in buildings was part of a series of material decisions made for the mass production of affordable housing within a technological framework that deemed it harmless and inexpensive as a complement to concrete and brick in medium-rise buildings. In this sense, asbestos sheets, roofing tiles, and pipes, along with other technologies, were mobilized by the promise of construction efficiency and low cost at a specific political moment, shaped by certain agents and their sustainability ideals. The persistence of asbestos use in construction materials is related to the duration of that technological framework and its promises, making asbestos an indicator of the extension of a set of conventions employed by Chilean society, at least in its material dimension.

Considering this, the period between 1990 and 2000 marks a terminal milestone of the technological conventions framework that began around 1930. Not only does asbestos shift from being considered harmless to toxic, but the serialization and standardization of social interest housing blocks also deconsolidate. Other low-cost materials and diverse building forms are explored as the production entities diversify, exclusively involving private construction companies. In this scenario, asbestos is not only prohibited as a construction material, but it also becomes a massive health vulnerability due to its extensive use in buildings from 1930 onward. This massive quality, along with its location on private properties and the costly nature of its detection and removal, articulates a type of material resistance or obduracy to leaving residential and urban environments, which has been partially addressed by governments using various targeted policies and programs. However, these measures fall far short of covering the majority of the problem, precisely due to its scale.

On the other hand, material governance also proves particularly challenging given the diversity of asbestos repertoires. It was used in alliances with other materials, in floors (tiles and flexit), walls (partitions), ceilings, and roofing (sheets), as well as in pipes, among others. Since its fragility, unlike concrete, increases over time, covering or strengthening it becomes inefficient. Thus, the only option is to remove it once detected, but detection requires observation and/or exploration of buildings, which could be addressed by the communities themselves if they were informed and trained accordingly. This requires instilling competencies in communities that facilitate the management of their own material environments.

Unfortunately, situations like these are not new. Similar scenarios, requiring constant exploration of the material environment, have been experienced in communities such as Puchuncaví, Quintero, Chañaral, among others. What makes this different is that it is not a material vulnerability emerging from the nearby environment, from which one can move away. Instead, it is a material vulnerability of the immediate surroundings that cannot be abandoned or altered, necessitating a different type of management, both by individuals and communities, as well as by the State.

Resilient situations of residential vulnerability like these require new types of interventions capable of informing and organizing different actors and fostering risk management competencies. This involves installing competencies for exploring and evaluating the material environment, such as designing risk management protocols. The experience of MINVU, in this regard, serves as a reference from which to learn, removing a significant number of buildings from risk. However, it's essential to note that their actions are consistent with being an institutional actor whose scale is different from that of any resident community.

Given this, the detection and data collection through a census becomes an interesting and replicable repertoire at the local level, articulating an incident information system at the housing level. This allows focusing, within a territory, an urbanization, or a municipality, on material risk intervention actions. Social Sciences can be useful in both the processes of installing competencies in communities and evaluating subsequent procedures, as this is a vulnerability that requires social persistence. Especially when dealing with asbestos-containing individual houses, the figure of co-ownership is not useful. Collective figures based on space and/or territorial history are more appropriate.

This last aspect connects the possible actions of local communities with the State, whose role is crucial for managing a type of residential vulnerability as described. The social contingency around asbestos in residential buildings highlights the need to consider the State as an active variable in the technological and material culture of societies, as well as various local communities. The material vulnerabilities described not only have a residential and urban scale and expression; they also constitute scenarios for intervention. Thus, both the State and communities are crucial to overcoming the different forms of obduracy presented.

This requires open information scenarios, the transfer of exploration and material analysis competencies to communities, and public debate on the technological frameworks used by societies. Public Science initiatives become not only relevant but also strategic for managing material risks in cities. Discussing the need for the latter type of policies to address material vulnerabilities like those described also implies instilling competencies for the technological and material decisions of society to be part of the public debate and, therefore, to be informed and expressed accordingly.

References

Acevedo Saavedra, C. P. y Cárdenas-Jirón, L. A. (2018). Barrios resilientes energéticamente en viviendas sociales: la reconstrucción post-incendio en el Cerro Las Cañas de Valparaíso. *Revista INVI, 33*(92), 183–210. https://revistainvi.uchile.cl/index.php/INVI/article/view/62782

Agenda País (2022). Municipalidad gestiona retiro de asbesto e instalación de colectores solares en más de 30 casas de la comuna. En, El Mostrador, 05 de enero de 2022. https://www.elmostrador.cl/agenda-pais/2022/01/05/municipalidad-gestiona-retiro-de-asbesto-e-instalacion-de-colectores-solares-en-mas-de-30-casas-de-la-comuna/

Arquitectura Urbanismo Construcción Arte., (2020). *Publicidad*. Revista Arquitectura, Urbanismo Construcción, Arte, Universidad de Chile. https://revistaauca.uchile.cl/index.php/AUCA/article/view/57408/60875

Boldú, J. y Pascal, I. (2005). Enfermedades relacionadas con los edificios. *Anales del Sistema Sanitario de Navarra, 28*(1), 117–121. http://scielo.isciii.es/scielo.php?script=sci_arttext&pid=S1137-66272005000200015&lng=es&tlng=es.

Bustos Peñafiel, M. (2020). Desafíos para enfrentar el deterioro de una producción cuantitativa. Vivienda social en copropiedad en Chile. *Bitácora Urbano Territorial, 30*(3), 247–261. https://doi.org/10.15446/bitacora.v30n3.86821

Chateau, F., Schmitt, C., Rasse, A. y Martínez, P. (2020). Consideraciones para programar la regeneración de condominios sociales en altura. Estudio comparado de tres casos en Chile. *Revista INVI, 35*(100), 143–173.https://revistainvi.uchile.cl/index.php/INVI/article/view/63348

Denis, J. y Pontille, D. (2020). Maintenance et attention à la fragilité. *SociologieS, Dossiers, Du pragmatisme au méliorisme radical,* 2–21. http://journals.openedition.org/sociologies/13936

Environmental Protection Agency (1991). *Indoor Air Facts No. 4 (revised) Sick Building Syndrome*. United States Environmental Protection Agency

Faria-dos-Santos, H., Sampaio, M., Mesquita, F. y Pereira, M. (2022). Crisis del sector sucroenergético en Brasil y la vulnerabilidad territorial de los municipios productores de caña de azúcar. Revista EURE - *Revista de Estudios Urbano Regionales, 48*(145).
https://doi.org/10.7764/EURE.48.145.02

García-Hernández, J. y Ginés-De la Nuez, C. (2020). Geografías de la desposesión en la ciudad neoliberal: ejecuciones hipotecarias y vulnerabilidad social en Santa Cruz de Tenerife (Canarias-España). *Revista EURE - Revista de Estudios Urbano Regionales, 46*(138).
https://www.eure.cl/index.php/eure/article/view/3036

González Castillo, P. (2021). Habitar entre arenas de relaves. Incertidumbre sanitaria y sufrimiento ambiental en Chañaral (Chile). *Revista INVI, 36*(101), 83–108.
https://doi.org /10.4067/ S0718-83582021000100083

Hernández, A. (1986). Tecnología y costo en la vivienda social. *Revista INVI, 1*(1), 12–26. https://doi.org/10.5354/0718-8358.1986.61934

Hommels, A. (2000). Obduracy and urban sociotechnical change. *Urban Affairs Review, 35*(5), 649–676. doi:10.1177/10780870022184589

Hommels, A. (2017). Re-Assembling a City: Applying SCOT to Post-Disaster Urban Change. In M. Kurath, M. Marskamp, J. Paulos & J. Ruegg (eds.), *Relational planning: Tracing artefacts, agency and practices* (pp. 205–227). Palgrave Macmillan. https://doi.org/10.1007/978-3-319-60462-6_9

Hommels, A. (2020). STS and the city: Techno-politics, obduracy and globalisation. *Science as Culture, 29*(3), 410–416. doi:10.1080/09505431.2019.1710740

Hommels, A., Mesman, J. & Bijker, W. (eds.) (2014). *Vulnerability in technological cultures: New directions in research and governance*. MIT Press.

Instituto Nacional de Seguridad e Higiene en el Trabajo (1991a). *Notas Técnicas de Prevención nº 288, Síndrome del edificio enfermo: enfermedades relacionadas y papel de los bioaerosoles*. Instituto Nacional de Seguridad e Higiene en el Trabajo.

Instituto Nacional de Seguridad e Higiene en el Trabajo (1991b). *Notas Técnicas de Prevención nº 289, Síndrome del edificio enfermo: factores de riesgo*. Instituto Nacional de Seguridad e Higiene en el Trabajo.

Joshi S. M. (2008). The sick building syndrome. *Indian Journal of Occupational and Environmental Medicine, 12*(2), 61–64. https://doi.org/10.4103/0019-5278.43262

Laumbach, R., Meng, Q. & Kipen, H. (2015). What can individuals do to reduce personal health risks from air pollution? *Journal of Thoracic Disease, 7*(1), 96–107. https://doi.org/10.3978/j.issn.2072-1439.2014.12.21

Marín Toro, A., Link, F. y Valenzuela, F. (2017). Arriendo en propiedad: arraigo y vulnerabilidad residencial en el barrio Puerto de Valparaíso. *Revista INVI, 32*(90), 127–157. https://revistainvi.uchile.cl/index.php/INVI/article/view/62769

Ministerio de Higiene, Asistencia, Previsión Social y Trabajo (1925). Decreto Ley 308 Decreto - Lei De Habitaciones Baratas. https://www.bcn.cl/leychile/navegar?i=5961&f=1925-05-01&p=
Ministerio de Salud (2000). Decreto 656. Prohibe Uso del Asbesto en Productos que indica. https://bcn.cl/2hfdq

Ministerio de Salud (2022). Decreto 71. Modifica el Decreto Supremo N° 656, de 2000, del Ministerio de Salud, que Prohibe Uso del Asbesto en Productos que indica. https://www.bcn.cl/leychile/navegar?i=1183745

Ministerio de Vivienda y Urbanismo (1998). Decreto Supremo 127. Modifica Decreto Nº 81, DE 1999. https://www.bcn.cl/leychile/navegar?i=140764&f=1999-08-19

Ministerio de Vivienda y Urbanismo (2006). Decreto Supremo 255. Reglamenta Programa de Protección del Patrimonio Familiar. https://www.bcn.cl/leychile/navegar?idNorma=257828

Ministerio de Vivienda y Urbanismo (2016). Decreto Supremo 27. Reglamenta Programa de Mejoramiento de Viviendas y Barrios. https://www.bcn.cl/leychile/navegar?idNorma=1114960&idParte=9885304

Ministerio de Vivienda y Urbanismo (2007). Ley 19.537. Sobre Copropiedad Inmobiliaria. https://www.bcn.cl/leychile/navegar?idNorma=81505

Ministerio de Vivienda y Urbanismo. (2015). *Vivienda social en copropiedad. Memoria de tipologías en condominios sociales*. Secretaría Ejecutiva de Desarrollo de Barrios del MINVU.

Moyano Díaz, E. (1994). Satisfacción con la vivienda en conjuntos residenciales de cooperativas y su relación con variables del mesosistema. *Revista INVI, 8*(20), 3–15. https://doi.org/10.5354/0718-8358.1994.62026

Niemelä, R., Seppänen, O., Korhonen, P. & Reijula, K. (2006). Prevalence of building-related symptoms as an indicator of health and productivity. *American Journal of Industrial Medicine, 49*(10), 819–825. doi:10.1002/ajim.20370

Organización Mundial de la Salud (1982). I*ndoor air pollutants: Exposure and health effects*. EURO Reports and Studies No 78, WHO Regional Office for Europe. World Health Organization (WHO).

Organización Mundial de la Salud (1986). *Indoor air quality research*. EURO Reports and Studies No 103, WHO Regional Office for Europe. World Health Organization (WHO).

Organización Mundial de la Salud (1987). *Air Quailty Guidelines for Europe*. WHO Regional Publications, European Series No. 23. World Health Organization (WHO).

Pérez Oyarzún, F. (2017). *Arquitectura en el Chile del siglo XX. Vol. II. Modernización y Vanguardia*. Ediciones ARQ.

Ruiz, A. (2019). El potencial de la percepción social aplicada al análisis de la vulnerabilidad en planificación urbana. *Revista EURE - Revista de Estudios Urbano Regionales, 45*(136). https://www.eure.cl/index.php/eure/article/view/2815

San Juan, C. y Muñoz, T. (2013). *Fibras grises de muerte: El silencio del mayor genocidio industrial en Chile*. UCA.

Sandoval, J.; Rojas, L.; Villalobos, M.; Sandoval, C.; Moraga, F. y Aguirre, N. (2018). De organización vecinal hacia la gestión local del riesgo: diagnóstico de vulnerabilidad y capacidad. *Revista INVI, 33*(92), 155–180. https://revistainvi.uchile.cl/index.php/INVI/article/view/62846

Sarmiento Prieto, J. P., Fritis Estay, A. y Castro Correa, C. P. (2020). Regeneración urbana y gestión del riesgo en Chile: análisis comparativo de casos. *Revista INVI, 35*(100), 174–198. https://revistainvi.uchile.cl/index.php/INVI/article/view/63336

Sepúlveda Mellado, O. y Carrasco Pérez, G. (1991). Reflexiones en torno a la producción serializada de viviendas sociales en Chile. *Revista INVI, 6,* 13-14. https://doi.org/10.5354/0718-8358.1991.62006

Sepúlveda Ocampo, R., Toro Blanco, A. y Arditi Karlik, C. (1991). Vivienda social: tecnologías apropiadas y proceso de cambio residencial. *Revista INVI, 6*(11). https://doi.org/10.5354/0718-8358.1991.61962

Tironi M. (2014). Hacia una política atmosférica: Químicos, afectos y cuidado en Puchuncaví. *Revista Pléyade, 14,* 165-189. https://biblat.unam.mx/hevila/PleyadeSantiago/2014/no14/8.pdf

Tironi, M. (2016). Algo raro en el aire: Sobre la vibración tóxica del Antropoceno. *Cuadernos de Teoría Social, 2*(4), 30–51.https://cuadernosdeteoriasocial.udp.cl/index.php/tsocial/article/view/26

Ureta, S. & Flores, P. (2018). Don't wake up the dragon! Monstrous geontologies in a mining waste impoundment. *Environment and Planning D: Society and Space 36*(6), 1063–1080. https://doi.org/10.1177/0263775818780373

Ureta, S., Mondaca, F. y Landherr, A. (2018). Sujetos de desecho: violencia lenta e inacción ambiental en un botadero minero abandonado de Chile. *Canadian Journal of Latin American and Caribbean Studies, 43*(3), 337–355. https://doi.org/10.1080/08263663.2018.149 1685

Vergara Vidal, J. y Asenjo Muñoz, D. (2019). El comportamiento infraestructural: prácticas relacionales en torno a la materia urbana. *Revista de Urbanismo, 40,* 1–13. https://dx.doi.org/10.5354/0717-5051.2019.51539

Vergara-Vidal, J. E., Álvarez Campos, D., Asenjo Muñoz, D. y Dintrans Bauer, D. (2022). Valores pragmáticos. La operación de la practicidad y la coherencia en la vivienda racionalizada CORVI. *Revista de Arquitectura, 27*(42), 110–125. https://doi.org/10.5354/0719-5427.2022.66414

Welz, J. y Krellenberg, K. (2016). Vulnerabilidad frente al cambio climático en la Región Metropolitana de Santiago de Chile: posiciones teóricas versus evidencias empíricas. *Revista EURE - Revista de Estudios Urbano Regionales, 42*(125).https://www.eure.cl/index.php/eure/article/view/1497

Zaccarelli, O. (1993). Informe al sector público. *Revista INVI, 8*(19), 5–18. https://doi.org/10.5354/0718-8358.1993.62022

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Author's Biography

Jorge E. Vergara Vidal is a Sociologist and holds a Master's degree in Social Sciences with a specialization in Sociology of Modernization from the University of Chile. He earned his Ph.D. in Sociology from the Alberto Hurtado University. Currently, he is an Associate Professor in the Department of Planning and Territorial Organization at the School of Architecture, Universidad Tecnológica Metropolitana (UTEM).

E-mail: j.vergara@utem.cl
ORCID ID: https://orcid.org/0000-0002-7712-4090