RECYCLING PLASTICS IN BALI: REINTRODUCING LOCALLY-SOURCED PLASTIC WASTE INTO THE CONSTRUCTION INDUSTRY AS A SUSTAINABLE BUILDING ALTERNATIVE

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Abstract

This research paper examines the challenge with pollution, specifically plastic waste, on the island of Bali, Indonesia, and aims to address it from an architectural standpoint. It studies the quantity of plastic waste and makes an estimation of its composition, leading to an understanding of the opportunities that the different types of plastics provide. The products of the discussed recycling processes are related to a vernacular Balinese basic housing unit, calculating the number of structures that can be built from them on a daily basis. Finally, it argues that the viability of the proposed intervention is dependent on certain conditions, such as responsible disposal and management of waste and the use of appropriate technology. Generally, the research proves that the amount of waste in Bali is enough to make a meaningful impact if addressed correctly, and that finding a solution to it could inspire similar actions in other locations.

Keywords: *Recycling, Plastic waste, Bali, Vernacular Architecture, Building With Recycled Plastics, Sustainability*

Figure 1. Pollution on the popular Kuta beach, Bali (Kennisgeving Voor Omleiding, 2019)

I. Introduction

1.1 The Global Problem of Waste

With rapid urbanisation and growing population, consumption is on the rise, and so is the global annual waste generation. Without immediate changes, global waste is predicted to increase by 70 percent on current levels by 2050. (Kaza et al, 2018) Plastics are especially problematic, as their mismanagement leads to the contamination of ecosystems and waterways, where they could remain for hundreds of years.

Until the 1950s, plastic was rarely used outside the military. Yet, since then it has been mass produced, and industries have so far generated more than 8.3 billion metric tons of plastic, 6.3 of which are now waste. (Science, n.d.) Of them, only 9% have been recycled and 12% have been incinerated, meaning that the remaining 79% are still lying somewhere on the planet. (Science, n.d.) At the current pace, by 2050, we will have produced 26 billion tons of primary plastic waste: waste of plastics that have not yet been recycled. (Geyer et al., 2017)

Waste management is now recognised as a pressing concern for many countries and solutions are sought at all scales: from the governmental level down to household initiatives. In March 2022 leaders of the UN member states endorsed an international legally-binding agreement to end plastic waste, addressing plastic's full lifecycle- from design to disposal. (United Nations Environment Programme, n.d.)

The need for reducing, and ultimately eliminating, single-use plastics is apparent, yet such a shift in consumer behaviour and production practices would be costly, timely and require strong incentivisation from governments globally.

Thus, while making the shift towards sustainable products and behaviours and an eventual fully circular economy, care needs to be taken of the already accumulating waste. Recycling plastics is a goal that needs to be addressed with urgency because it can have positive impacts on multiple levels: from reducing environmental pollution, through providing opportunities for the use of reclaimed materials for new products, to boosting local economies through providing more job positions and potential export commodities. Thus, it is integral to define efficient ways of managing plastic waste and re-introducing it as a valuable resource, turning it into a circular end to the current linear economic model.

1.2 Waste in Bali, Indonesia

Indonesia is the biggest plastic pollution contributor after China due to its overconsumption of single-use plastics and the insufficient waste management policies and implementation. (Beat Plastic Pollution, 2022) Its goal is to reduce ocean plastic leakage by 70% by 2025, which demands massive investments in waste management infrastructure. (Airbnb et al., 2022) However, to achieve the level of sustainability that the planet would need in the coming decades, systems should ultimately be planned for scenarios where 100% of the generated waste is addressed.

Within Indonesia a location that is experiencing the waste problem strongly and at the same time is receiving increasing international attention is the island of Bali. In the past years, Bali has become an epitome of overpollution and overtourism- a location which is strained by the unsustainable practices and irresponsible behaviours employed in it. Until 60-70 years ago the waste produced on the island was all organic and biodegradable, which had led to the habit of disposing it into the environment. However, with the rise of the consumerist culture and the use of plastics, the old ways of dealing with waste have started causing damage to the environment. In 2021 the government declared a waste emergency and closed down the biggest landfill which had been operating beyond its capacity. Waste is being massively mismanaged and is leaking into nature, contaminating the land and water, threatening marine life and polluting the soil. Tourism, constituting 80% of the local economy, and population growth are leading to increased demand for resources and growing amounts of waste. Meanwhile, Indonesia is working towards attracting ever more tourists, reaching 20 million international arrivals by 2020 (a goal which has been postponed due to the coronavirus pandemic), which is nearly double the unprecedented heights of 11 million in 2019. It is estimated that tourist activities generate 3.5 times more waste than locals', and if the issue of waste collection and management is not addressed, the island's ecosystem could collapse on its own success. So far the local government has banned single-use plastics like straws and plastic cutlery, but due to the lack of law enforcement, the ban is often bypassed (Ismawati, et.al, 2022). Yet, a positive side to Bali's international popularity is its image as a destination for ecotourism. The tourist expectations formed by it, the comparative wealth of the province and the push of expatriates towards achieving such a reality for the island make it a good place to start implementing circular and sustainable practices in Indonesia.

Relating this to the field of architecture, the planned increase in the number of visitors to the island creates a demand for new buildings and infrastructure: where would those people live, work, study, go for entertainment? And how could the island strive for sustainability when the growing demand is straining its current systems?

This paper looks at waste, in particular plastic waste, as a valuable and locally-available resource with a constant influx, rather than a problem, and examines how the architecture field could use that growing supply to satisfy the growing demand for new construction on the island of Bali.

II. Methodology

2.1 Research approach

To satisfy the topic of this research, two main themes need to be examined: that of plastic waste (the recyclability and properties of plastics, available recycling technologies, etc.) and that of plastic waste in Bali in particular (quantities, current issues, needs of the location, etc.). (Fig.2)

To understand the potential of recycled plastics being used in the construction industry in Bali, the amounts of plastic waste generated on a daily basis on the island will be examined, and its composition will be noted. This part of the research utilises a quantitative study of material flows, for which the information is acquired through literature studies, online sources and interviews with local institutions in Bali. MFAs (material flow analyses) are a method for analysing the state and change of materials flow and stock within a defined system in space and time. (Brunner and Rechberger, 2017)
Such analysis would illustrate the opportunities that plastic waste provides as a potentially utilised material and also visualise whether the new recycled plastic components would satisfy a portion of the market, or go further to create an oversupply, which would necessitate the export of materials to nearby islands.

Depending on the types of plastic that the waste is made up of, different appropriate recycling technologies will be identified. Selection will be made based on the usefulness of the process's final output in relation to the elements of a vernacular house unit. The quantitative examination of a local structure presents the architectural components that are needed to execute a locally appropriate building. Eventually, that will help determine how many of those buildings could be constructed with the available plastic per unit time (one day). With that, the aim would be to reveal the value that is being lost due to the mismanagement of waste and hence how much the local community and the local environment could gain if such an approach to recycling plastics is embraced.

Appendix 1

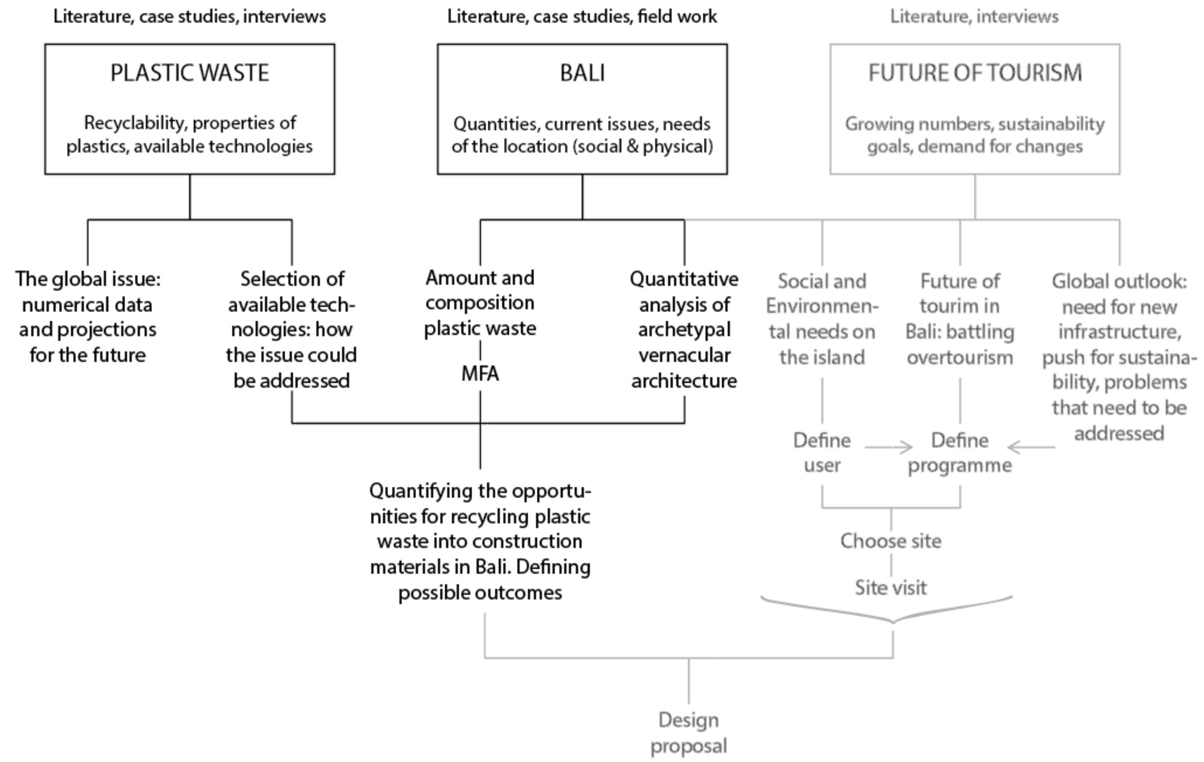

Figure 2. Structure of the present technical research (in black) and consequent design research and project (in grey). Designed by author.

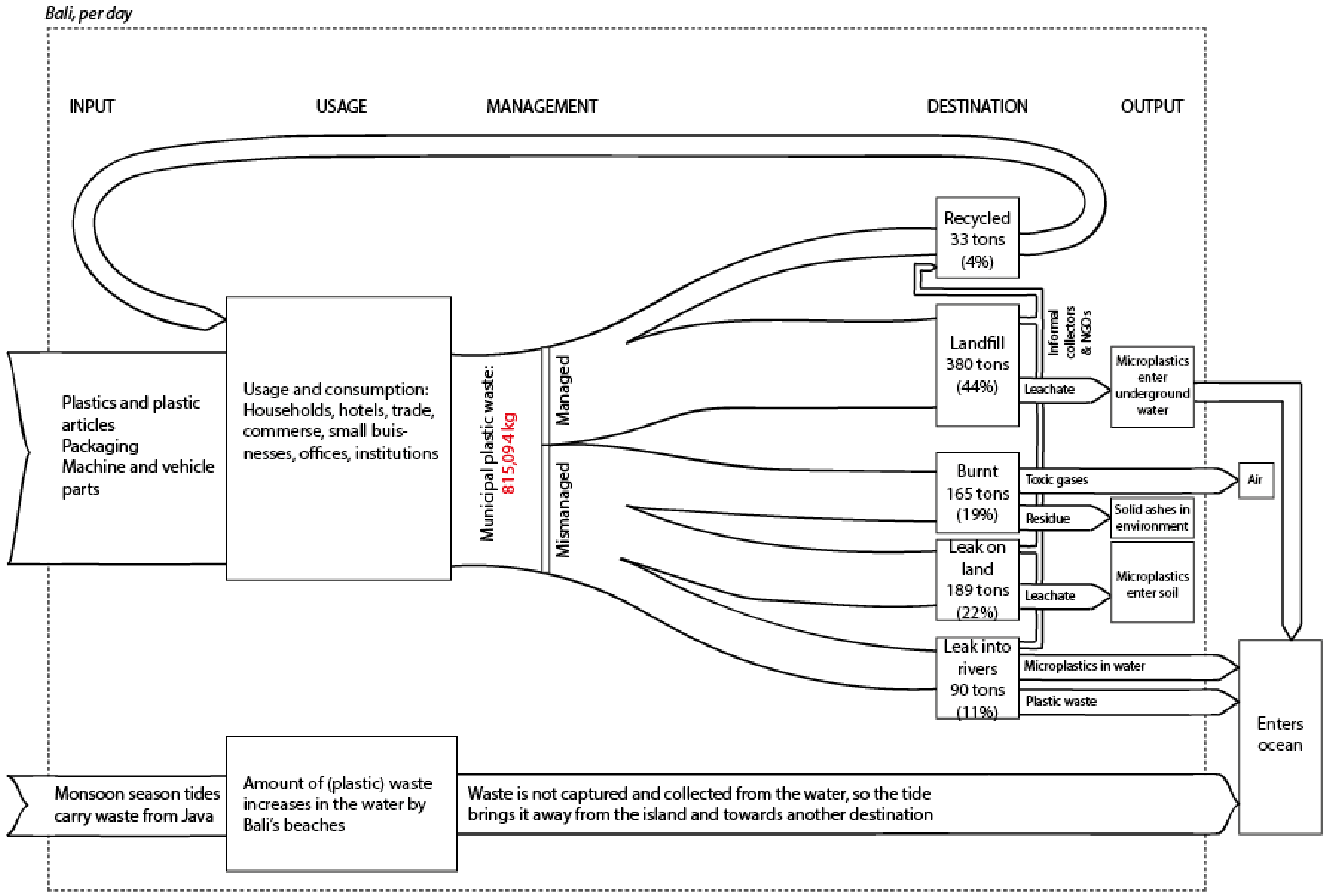

Figure 3. MFA of current plastic waste flows in Bali. Graph by author.

A visionary approach is applied when calculating the amounts: one where all of the plastic is collected and all of it is recycled for the purposes of the construction industry: no type of plastic is labelled as “unrecyclable”.

The design project that will follow from the results of this research will be related also to the topic of the future of tourism and informed by a site visit and qualitative research of the characteristics of local Balinese architecture.

2.2 Material Opportunities: Quantifying the Problem

To establish the potential benefits that recycling plastic waste into construction materials can have to the material flows of the current linear economy, it is necessary to understand the quantities that can be used. In Bali, waste is mostly municipal, which includes household waste, waste from hotels, commerce and trade, office buildings, institutions and small businesses. (“Municipal Waste,” 2017) These are the main contributors to pollution on the island, as there are no heavy production industries there.

The Bali Partnership, a collaboration between the local government and Norway, has investigated the flows of waste on the island, mapping the locations and amounts produced, mismanaged, leaked into nature, incinerated, etc. This information provides a solid ground for a research like this current one to start from.

According to the organisation, in Bali 4,182,000 kg of waste are generated each day, from which 815,094 kg are plastic. The current rate of recycling is around 4%, which is between 2 and 3 times lower than the global average. (Bali Partnership, 2021) More than half of the waste (52%) is mismanaged, ending up in the natural environment or being burnt by individuals close to their homes due to the lack of options for disposing of it locally and safely. (Fig. 3) Almost all of the collected waste (44% out of the 48% collected) ends up in landfills, and only 4% is recycled. Additional amounts of plastic become available when the monsoon season tides bring waste from Java to the shores of Bali. Considering Java’s size and its population of 150 million, capturing even a portion of that waste could be significant to a process such as the one which this paper proposes. Due to the uncertainty of numbers, this research would not include ocean plastics in its calculations. However, it should be noted that they can dramatically increase the quantities of available plastic, if captured efficiently from the water. Employing the practices that this paper proposes in Java would allow for decreasing the amounts of ocean plastic.

The methods in which plastic pollution is dealt with currently on the island poses a number of environmental threats. Items that enter the rivers (and later the ocean) begin decomposing into microplastics which threaten marine life; ones that remain on land release microplastics and contaminate the soil, unregulated burning releases toxic gases and accumulates solid ash residue which can be spread by the wind and inhaled by humans. Even the responsibly managed waste brought to landfills can not be considered safe, as with time, toxins are washed by rain into the soil and the leachate ends up mixing with underground water. Thus, even with policies for more efficient collection of municipal waste, piling it up on the island is no longer a desired option due to the space scarcity and negative environmental consequences. Exporting it to other locations, as some islands do, would only mean postponing the emergency. Thus, recycling and repurposing appear to be the reasonable next steps in the island’s sustainable development.

The potential for waste-recycling is traditionally considered dependent on the types of waste present in the stream of materials, as each polymer behaves differently when processed, thus being labelled as easy or hard to recycle. The most common types of plastics have been divided into 7 categories for recycling, going from more to less recyclable: PET, HDPE, PVC, LDPE, PP, PS and Other. (Fig. 5)

APPENDIX 2

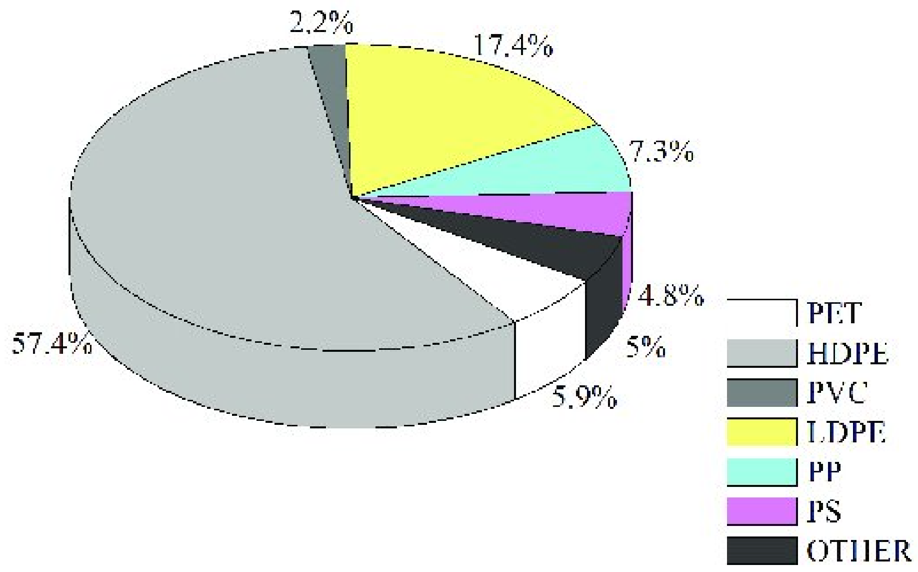

Figure 4. Composition of municipal plastic waste (MPW) by weight in Bangkok, Thailand, used as a reference for this study (Areeprasert et al., 2017)

Table 1: Types of plastics and their recycling and re-use potential (Seaman, 2012)

Plastic Type	Example of applications	Assigned number and recycling and re-use
PET	Salad dressing containers, processed meat packages, plastic soft drink and water bottles.	1 1) recycled but not re-used
HDPE	Milk bottles, shampoo bottles, detergent bottles, oil jerry cans, and toys	2) re-usable and recyclable
PVC	Fruit plastic packing, sweet trays and blister packaging.	3) not recyclable nor re-usable*
LDPE	Bread bags, frozen food bags, squeezable bottles, fibre, bottles, clothing, furniture, carpet, shrink-wraps and garment bags.	4) re-usable but rarely recyclable
PP	Margarine and yoghurt containers, caps for containers, and wrapping to replace cellophane.	5) reusable but rarely recyclable
PS	Egg cartons, fast food trays, and disposable plastic silverware.	6) reusable but rarely recyclable
Other	This includes an item which is made with a resin other than the six listed above or a combination of different resins	7) none – not recyclable nor re-usable except those with polylactic acid (PLA) coding underneath

*Although it is not recommended to re-use PVC, it can be repurposed for other functions excluding food and children use

Figure 5. List of the 7 types of plastic, their recyclability and usability, and examples of their application (Gwada et al., 2019)

Current technologies have allowed for all plastics to be deemed recyclable, and this paper embraces that statement. Still, a breakdown of the quantities of the different types present in Bali's waste stream is integral for establishing the possible new products that can be derived from them. Due to the insufficient collection of municipal waste, the composition of plastics in it is not precisely determined and thus not officially published by the local government. Therefore, an estimation of the percentage of each type of plastic is made based on data from locations with similar characteristics as Bali.

The current quantities are based on the municipal waste composition in Bangkok, Thailand, in terms of weight as follows: HDPE (57,4%), LDPE (17,4%), PP (7,3%), PET (5,9%), PS (4,8%), PVC (2,2%), Other (5%). (Fig.4) However, the activities at a location have a strong impact on the types of waste that it generates (depending on the presence of industries, specific patterns of use, etc). Thus, these quantities will be updated after the author's visit to the location and interview with a waste collection/ recycling facility.

2.3. Available technologies

An integral part of this research is a study of the processes of plastic waste recycling that are currently available. Out of the technologies that yield products appropriate for use in the built environment, 3 general approaches have been identified. They have been grouped based on their ability to reproduce the main elements of vernacular Balinese architecture while efficiently using all available types of plastic, even the hard to recycle ones.
Within the recycling technologies discussed, the paper does not examine or question the processes on a chemical level but rather assumes their ability to produce structural elements for architectural use.

2.3.1 3D printing from recycled plastic filament

Creating 3D printer filaments from recycled plastic is the most selective of the methods available. The common types of plastic that can be recycled into 3D printer filaments are HDPE and PET, since they are most easily processed. (Bombardi, 2022) The resulting products are structurally the weakest compared to the methods discussed below but also allow for the greatest detail. Thus, this method is the best one for making the typical for Bali ornaments and decorations for walls and roofs. It also provides an opportunity for designing bespoke shapes and adapting them for the specific needs and likings of the clients.
Also, whole houses can be 3D printed from plastic (Fig. 6) but that is not an efficient way to address the issue, as the method is highly selective and would leave multiple types of plastic unused. The goal of this research is to find optimal ways to use all plastics in the construction process.
Depending on the type of plastic used in the process, objects with varying rigidity can be produced and thus be used for different purposes: from decorative pieces, to facade elements.

2.3.2 Melting and moulding/ Injection moulding

The process of melting and moulding plastics allows for the creation of multiple elements of a particular shape and size. Due to the requirements for melting, the process is again selective, yet allowing for more types of plastic to be used than in 3D printing. Technically, all of the 6 types of plastics collected for recycling are thermoplastics, meaning that they can be melted and reshaped into any form. However, due to the items they usually appear as and the combinations in which they are often used, makes some of them harder to recycle. Thus, the types that are likely to be used in this process are again HDPE, LDPE, PVC and PP. (AdrecoPlastics, 2021) The resulting products can be aesthetically pleasing and gentle, and the colour and shape can be controlled.

APPENDIX 3

Figure 6. A fully 3D printed house in Amsterdam, designed by DUS Architects (van Duivenbode & van den Hoek, 2015)

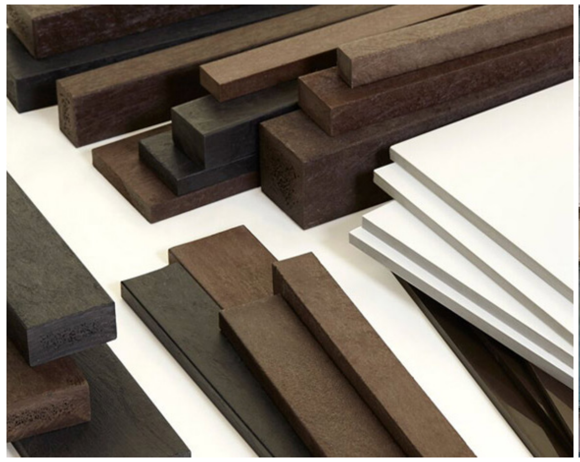

Figure 7. (left) Recycled plastic structural lumber (AdrecoPlastics, 2021);
Figure 8. (right) Pretty Plastics: facade elements from recycled PVC. (Schoepp, 2022)

Figure 9. Blocks and interlocking system for structural walls, kept together by metal rods and vertical compression (ByFusion Global Inc., 2022)

Examples of that include plastic facade elements, panels or other smaller plastic bricks (ex. *Pretty Plastics*) (Fig. 8). They could also be used as roof tiles, flooring, etc. A product that is gaining popularity is recycled plastic structural lumber (Fig. 7), which has already been used in buildings, decks, bridges and retaining walls. (Recycled Plastic Lumber Invented, n.d.) It could be suitable for use in the Balinese architectural vernacular setting, which will be discussed in the next chapter. The actual structural qualities of recycled structural lumber are still to be determined scientifically and they might affect the design phase of this project (dimensions of columns and beams, grid size, need for additional supports, etc).

2.3.3 Compressing into blocks

This final technology integrates the "hard-to-recycle" plastics into the push for sustainable building materials. The process uses only steam and compression, no melting and no additives or fillers, which allows for multiple types of plastic to be used and leaves virtually no type unrecyclable. The plastics used in the previously mentioned processes can also be used in this one, in case these structural blocks are of higher demand than the other products. Different companies like *ByBlock* (Fig. 9) and *Uppact* have developed techniques for constructing with those blocks: from lego-like stacking to railing them on vertical poles. Manufacturers claim that the blocks are more rigid than concrete ones and can be used for the construction of walls, bases, and any bulky element that needs to perform in strength.

III. Results

3.1 Possible implementation of plastics in the local architecture: Study of the elements of an archetypal vernacular house

To establish what architectural elements need to be manufactured for the local construction market, a close look at a vernacular structure would be useful.
Traditional Balinese houses have an organisation different from western ones: instead of consisting of one building with rooms, they are compounds, surrounded by walls, and contain several independent units, the number of which depends on the size of the family which owns the house (Fig.11). In order to find a middle ground between that specificity of the vernacular and a way of communicating with western readers through the easily graspable concept of a house, a single, standard and replicable dwelling unit from a Balinese compound will be examined.
Each unit is an open structure on a thick base, with a pitched roof (covered with alang-alang or roof tiles), supported by a timber frame and sometimes featuring free-standing non-loadbearing walls. (Davison et al., 2014) (Fig. 10)

Balinese architecture is based on proportions rather than actual metric measurements. The rules relating to the ritual and practical matters of Balinese construction are described in sacred texts (Asta Kosali) kept by the village priest. Measurements are based on the size and proportion of the human body, and more specifically, that of the owner of the house. The dimensions of house posts are based on those of the hand. The ideal width between columns is considered to be five elbows. If that is translated to a system that the international architectural community is used to working with, it would mean a more or less 2x2m or occasionally 2x1m grid.

Based on common architectural understanding of what the size of a convenient and functional space for the whole family could be, the calculations will be made for a building of 24sqm (4x6m). Columns would be approximately 250x15x15cm. The viability and specifics of the structural use of recycled plastic is not a subject of this study but may be researched further during the design phase of the project.

Appendix 4

Figure 10. A residential unit from a Balinese vernacular housing compound.
"Bale dauh is a room specifically designed for the boys or male bachelors living in the traditional house. Sometimes, bale dauh can also function as a place for meetings and organising daily activities such as weaving, carving, painting, and sculpting." (*Traditional Houses in Bali - Indonesia Travel*, n.d.)

Figure 11. A Balinese vernacular housing compound. The buildings, bale, are open on one or more sides. Roofs can be either covered with bale or with roof tiles and ornaments depending on what the family can afford (Bali Around, 2013)

With the given dimensions, the resulting volumes are as follows:
Columns (9): 0,5m³ total
Beams (5): 0,32m³ total
Base: 14,4m³ total
Walls (2): 4m³ total
Base and wall finishes: 78,8m² total (if 1cm boards, then 0,78m³)
Roof rafters: 3,52m³ total
Roof surface: 42m² total (if 1cm roof tiles, then 0,42m³)
Ornaments: 0,5m³ total (may vary)
Total volume of house: 24,84m³ of compressed plastic waste.

This is a precise estimation of how much material the building of such a structure would require, yet in its raw shape, plastic waste is not condensed and a cubic metre of it can vary in weight depending on its composition. A useful reference can be the technology developed by ByFusion: *ByBlock*. The compressed blocks are manufactured without losses and have standard sizes: 20x20x40cm and weigh 10kg. This means that one cubic metre of compressed waste weighs 625kg.

Thus, one house weighs around 15,250 kg, or just above 15 tons.
With the daily yield of 815,094 kg of plastic, this means 54 such housing units can be built daily.

3.2 Export of excess materials

Depending on the need for new construction in Bali, this material could either be used locally, or exported (Fig. 12). However, since the quantities are large, they are likely to exceed the demand, so using them at nearby locations might be the right step forward. In 2019 the Indonesian government launched the *10 New Bali* project which targets the development of 10 islands as sustainable tourist destinations with the aim of decentralising the growing influx of international tourists in Bali. These islands will follow their archetype's model for touristic appeal but provide more eco-friendly solutions and infrastructure capable of handling the increasing amount of people. Using the approach to recycling plastics that this paper suggests, the newly produced building materials can be used for the construction of those 10 new destinations, further enhancing their sustainability profile, presenting them as innovative and at the same time easing Bali of its overwhelming pollution.

3.3 Substitution of current less sustainable or labour-intensive practices

Currently the Balinese construction sector is dominated by concrete, and local contractors pride themselves with the durability of the material, promoting it as the optimal solution. Yet, the architectural field has now acknowledged the general shortcomings of the material in terms of sustainability: the production of cement uses fossil fuels and releases CO_2. (Reilly, 2021) In addition, to provide concrete in Bali, cement is imported from China, South Korea and the Netherlands, further increasing its carbon footprint. (International Trade Centre, n.d.)
Some approaches to localising the building sector have been applied by companies and initiatives that are actively preserving, modernising and popularising the know-how of building with bamboo (ex. *IBUKU* and *Asali Bali*). This architecture is sustainable, aesthetically pleasing and exciting, and has helped establish Bali's name as a progressive and eco-friendly destination. Yet, the few internationally popular buildings that embrace bamboo as a main structural material, have been meticulously designed by architects and executed by carpenters, which may not be available to lower-budget spatial interventions initiated by families or communities. Still, the search for more locally-appropriate and available materials and building techniques is a fact. This creates an opportunity for a new "local" material to be incorporated: recycled plastic, opening the potential

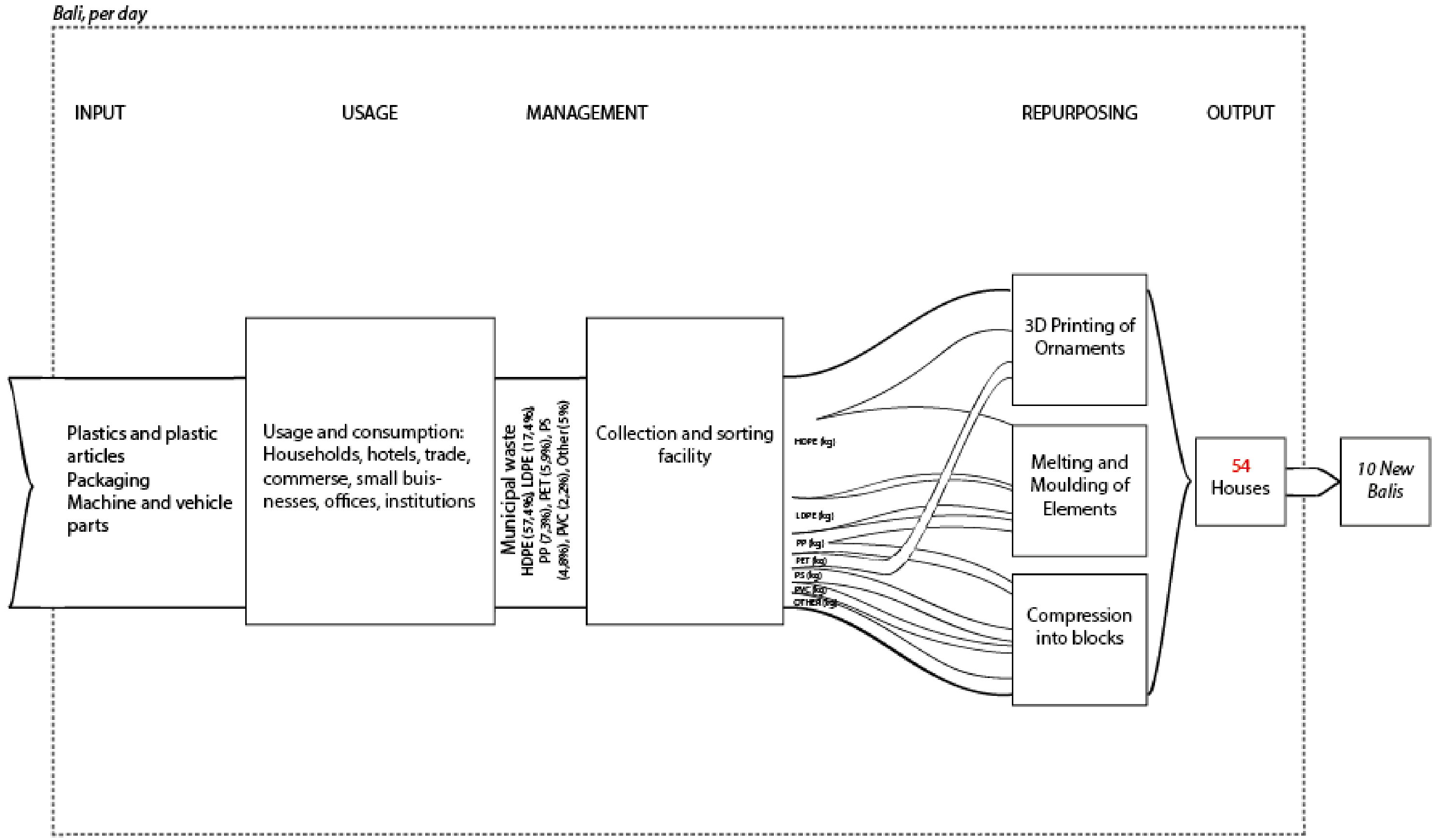

Figure 12. Proposed MFA for the system boundary of Bali per day with the implemented approach of recycling plastics into building materials. Graph by author.

IV. Conditions

The current recycling rates worldwide are not high enough to sustain the speed of waste production. In fact, in Indonesia they are as low as 11-12% in total. Thus, turning this paper's proposal into a reality can only be viable under certain conditions.

Firstly, waste needs to be disposed of responsibly and collected dully by governing bodies, which is often the biggest challenge. In some high-income countries like Germany and the Netherlands, waste collection is advanced and recycling rates reach as high as 68-70%. Reaching that requires cooperation between governments and locals in terms of providing and utilising convenient and available disposal facilities. A goal in Indonesia's 2020 Action Plan is to double plastic-waste collection (from 39% to 84%) by 2025 by boosting state-funded and informal or private sector collection systems. (Global Plastic Action Partnership, n.d) Building the needed infrastructure, as well as planning and maintaining the systems' operation would require significant investment. Yet, considering the negative impacts of waste mismanagement and their potential for causing an ecological crisis, compromising the health of local residents and leading to a loss of tourist numbers at a location that heavily depends on them, it would be much more costly not to address it.

Secondly, investment is needed in waste sorting infrastructure. Much of the waste that is collected and submitted for recycling now in Bali in particular is sorted by hand. The inefficiency of this process makes it too costly and slow to be sustained, so if the plastic waste problem is to be tackled on the island, it needs to be modernised and automated. Mechanisms have been developed to recognise and sort different types of plastic waste, allowing for more precision in the process and less human workforce involved in it.

In addition, globally, collaboration between package designers and recycling entities would be essential to ensure the products that end up in recycling bins consist of materials that are reusable and/or recyclable and satisfy the needs of stakeholders throughout the products' lifecycle.

Also, with the current economic reality, the use of virgin plastics is more affordable than that of recycled ones. However, plastic is made out of crude oil, which is a commodity that the world is ultimately trying to shift away from, and one that is going up in price. Thus, a power shift towards making recycled plastic cheaper and hence the more desirable material is needed, and is possible. If treated as a business and fuelled by private initiative, economist and businessman Andrew Forrest estimates that it would take a global investment of 300 million USD over the period of five years. (TED, 2019) If addressed at a public national level, it is achievable through governmental incentivization: for example, introducing taxes on virgin plastics, making it cheaper for producers to use recycled and repurposed materials instead (which, however, would affect the end consumer). Hence, with the proper motivation, that condition could be achieved within a few years.

Finally, an aspect of the proposal that needs consideration is the architectural use of recycled plastics. A benefit to the material is that due to its longevity, in buildings it may require low maintenance and only occasional updates, compared to wood or bamboo.
What needs to be further investigated are the health implications that buildings made out of plastic can have for their occupants: whether the microplastics that would potentially be released from surfaces would have a significant negative impact compared to other materials. Also, due to plastic's non-porosity, additional measures may need to be taken to avoid increased humidity in inhabited spaces and ensure proper ventilation. From that point of view, the openness of Balinese architecture to nature may be an additional argument in favour of Bali's appropriateness for such an experiment.

V. Conclusion

This paper examines whether and how plastic waste could be turned into architecture, using the island of Bali as a case study. The discovered information and quantities prove the presence of an issue with pollution in Bali and later the study of technologies and the appropriateness of their output for the chosen context provides a potentially viable way to address it.
The amount of waste present and accumulating on the island justifies the need for a move towards recycling on-site at the location. The elements needed to produce Bali-appropriate architecture are achievable through the available technologies. The inflow of plastics allows for a significant number of basic house units to be produced on a daily basis, so such an intervention could be justifiable in light of the growing need for architecture and infrastructure on the island, fuelled by the growing population and tourism sector. The excess of construction materials could be exported to nearby islands and support their sustainable growth.
Of course, that is possible under a number of conditions, such as responsible disposal and collection of waste, acquisition of modern recycling facilities, and a general shift towards prioritising the use of recycled plastic. There is a long-term environmental, social and economic benefit in taking those steps in the development of waste management at a global and local scale, so they are likely to take place in the near future. Conducting such an experiment in Bali and proving its potential to work efficiently, could become a precedent for other locations with similar characteristics: popular tourist destinations and island nations. Thus, if done well and at a place that attracts international attention like Bali, such an intervention could be of global significance and serve as an example and inspiration towards the general positive sustainable development of the planet.

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