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Ecoeficiency and Enviroment Ergonomics to the production of ceramic bricks in the Brazilian Amazon

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Abstract

This paper presents an ecodesign strategy concerning the improvement in the production efficiency of structural ceramic using traditional kilns in the Brazilian Amazon region. We propose to reduce the consumption of firewood or energy inputs during the process of burning ceramic blocks by combining two interventions. First, a technological adaptation of a conventional burning system widely used. Second, the deployment of a clean burning combustion process. Based on ecoefficiency and environmental ergonomics parameters, we derived an analytical geometrization on two types of brick kilns. The primary goal is to develop a systematically, new firing system with aspects that are functional, formal, ergonomic, environmental and technological as well. This research is engaged in creating innovative products based on the three fundamental subsystems of the Concurrent Design Model: formal, functional and ergonomic. The focus is on the definition of all components intervening in the design process to the product specification.

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Keywords: Tradicional Kilns; energy inputs; environmental ergonomics.

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1. Introduction

The burning phase is considered one of the most important stages of the whole production process of ceramic blocks. Various properties of clays manifest through physical, chemical and mechanical changes caused by the action of heat from the fire.This research analyzes two traditional systems of ceramic cooking, proposing an analytical systemic geometrization based on the method suggested by [1],[2] and [3]. This method is based on oriented practices, more accurately, for the analysis and development of functional, formal and ergonomic aspects of the production of bricks and tiles. The ecodesign practice provides the means for this to be possible, serving as a strategic approach to the target project.

As we seek to improve production efficiency, we consider some approaches to reduce firewood consumption or energy inputs in the firing phase of the ceramic blocks. Based on the results of this intervention, we propose the creation of a more efficient burning process, through technological adaptation between conventional system already used in the region and the combustion process by clean burning [4].

The result of this work significantly helps the development of the suggested product, from conception to production. The primary objective is to enable the reduction of adverse environmental impacts arising from the process of burning the blocks and ceramic tiles.

The results can also contribute significantly, both for the society and for the science. The former will have access to an efficient and thermally comfortable eco product. The latter will be the scenario for discussions and prototyping, addressing another production of sustainable nature.

Nomenclature

RS	Reference System	*InV*	Input Variables
OuV	Output Variables	*IV*	Information Variables
AV	Action Variables	*SS*	Subsystem
VU	Volume of Use	*US*	Use Surface
BS	Boundary Surface	*FS*	Fundamentals Systems
ErSS	ErgonomicSubsystem	*FoSS*	Formal Subsystem
FuSS	FunctionalSubsystem	*OS*	Outer System
EV	Essencial Variables	*FuO*	Functional Objetives
ErO	Ergonomical Objetives	*FoO*	Formal Objetives

2. Teoric Basis

The traditional bricks industry employs as primary fuel the native wood (50%) and wood waste (40%): chips, sawdust, briquettes and other waste. Industrial data indicate a trend to increasing use of wood from reforestation in order to achieve energy sustainability, leading to a surplus of biomass for wood marketing. However, according to [5] there is still a need for interventions by the public sector with respect to the development of reforestation programs in the Amazon facing this industry segment.

The ceramic block, also known as eight-hole brick, is the ceramic product most consumed in Manaus. 90% of the blocks come from Manacapuru and Iranduba, cities located on the right bank of the Rio Negro. The production is distributed as follows.

1) 25% are large brick kilns, with a production capacity of up to 50,000 bricks per day;
2) 25% are medium-sized potteries, with an average capacity of 30,000 bricks daily;
3) 50% are small potteries, which are no more than 10,000 bricks per day.

However, this material causes a high loss rate in construction, reaching an average of 13% [5].