



**Universidad Andina de Cusco**  
Facultad de Ingeniería y Arquitectura  
Escuela profesional de Ingeniería Civil



**Universidad  
Andina  
del Cusco**

Tesis

---

"Evaluación del Comportamiento Físico-Mecánico de las Unidades de Ladrillo de Concreto para Albañilería, elaboradas con Árido de Residuos de Construcción y Demolición (R.C.D.) y cemento Pórtland tipo IP, fabricadas en la Ciudad de Cusco"

---

Línea de investigación: Ingeniería e innovación tecnológica.

Presentado por:

Cevallos Chachaima, Carlos Raúl.

Ninancuro Calluco, Margareth Shirly.

Para optar al título Profesional de Ingeniero Civil.

Asesor:

Dr. Ing. Victor Chacon Sánchez

Cusco - Perú

2021



incidencia (100% - presente en todas las muestras) y presencia (55.75% en cantidad promedio respecto al total de la muestra) del Grupo A, compuesto por concreto, ladrillos, tejas y materiales cerámicos de acuerdo al protocolo europeo, por lo tanto fue el material que se opta a utilizar, lo que a su vez genera que las muestras obtenidas del R.C.D. procesado estuviesen compuestas por concreto, ladrillos, tejas y materiales cerámicos. Seguidamente al ensayar el material obtenido por granulometría, se determinó que se tiene una proporción agregado grueso a agregado fino de 4 a 1 aproximadamente (80.13% a 19.80 exactamente) %, del cual se utiliza netamente el material considerado agregado fino por tratarse de un diseño de mortero.

Finalmente, de los resultados de los ensayos clasificatorios para las unidades de R.C.D. se obtiene que las unidades elaboradas con árido R.C.D. y cemento portland tipo IP, cumplen con todo lo indicado por el R.N.E. Norma Técnica E.070 Albañilería, (2006), para Bloque tipo P(1): Para el ensayo de variación dimensional se obtienen los resultados: +0.30% y -0.30% para el largo, +0.77% y -0.70% para el ancho, +1.17% y -1.15% para la altura cumpliendo en todas las dimensiones con la norma técnica que indica una variación dimensional menor al 2.0% respecto a la dimensión siendo evaluada. Para el ensayo de alabeo se obtienen como resultados: para convexidad 3.00 mm y para concavidad 1.50mm, por lo que considera que el alabeo máximo con valor de 3.00 mm, cumpliendo con la norma técnica que indica un alabeo menor que 4.00mm. Para ensayo de resistencia a compresión característica a los 28 días se obtiene el resultado de 148.01 kg/cm<sup>2</sup> para un grupo de 08 muestras, cumpliendo con la norma técnica que indica al menos 50.00 kg/cm<sup>2</sup>

Palabras clave: Unidad de albañilería, manejo de residuos de construcción y demolición, bloque, reutilización, procesado.



## Abstract.

This research was oriented at evaluating the physical-mechanical behavior of masonry concrete units made from aggregate of construction and demolition waste (CDW) and Portland cement type IP manufactured in the city of Cusco, contrasting the results with what is required for the classification of masonry units by the R.N.E. Technical Standard E.070 Masonry, (2006) to determine the capacities and means in which these can be used.

First, a survey was conducted to the public functionaries e material dispatchers whose functions were related to the management of the CDW, then CDW samples were classified by the European protocol and local Peruvian regulations (solid waste law, handling and management) both before and after being processed. Being that a mortar design was being used, it was decided to use the CDW aggregate as a replacement for the fine aggregate in the mixture, for which the CDW aggregate was tested for moisture content, granulometry, Atterberg limits, specific gravity and absorption percentage from the fine aggregate.

The supplies and materials for the mortar (cement, water and aggregate) of the masonry units were studied and analyzed prior to the mix design.

After the mix design, 18-hole block-type masonry units were made with approximate dimensions of 23.3, 13.6 and 8.6cm in length, width and height respectively, poured with the calculated dosage, a total of 53 units were made because 3 of them were damaged in the demolding process. Of these, half of the units were destined for destructive tests as follows: 12 units to be tested to compressive strength in units, 4 units for each age of 7, 14 and 28 days, 4 units to be tested to modulus of rupture for an age of 28 days and finally 9 to be tested in piles of 3 units for the age of 28 days to compressive strength in piles in a complementary way to this research. The other half was destined for the non-destructive tests of dimensional variation, warpage, weight, absorption, maximum absorption, suction and percentage of voids.

The results of the surveys indicate that of the public functionaries 90.91% of the total have a basic level of knowledge regarding the CDW, while the material dispatchers have a level between null and minimum 73.33% and 26.67% of the total respectively. The results obtained from the unprocessed RCD material indicate that within the samples there was a higher incidence (100% - present in all samples) and presence (55.75% in average quantity from the total sample) from Group A, composed by concrete, bricks, tiles and ceramic materials