 doi:10.20944/preprints202103.0666.v1

A study on Different Bricks & Identification of Quality of Bricks Based on Existing Data

Md. Numan Hossain
Email: numan.hossain10@gmail.com
Dept. of Petroleum & Mining Engineering, Shahjalal University of Science & Technology, Sylhet, Bangladesh.

Abstract:

The purpose of this study is to investigate the different types of bricks as a construction material. In this study, monitoring different technical specification or characteristics of the bricks. At the end of study, Brick Quality Index (BQI) evaluated. According to BQI, bricks were classified poor to excellent quality.

[**Keywords:** Bricks, Bricks Types, Technical Specification of Bricks, Building Materials, Brick Quality Index]

Preprints (www.preprints.org) | NOT PEER-REVIEWED | Posted: 26 March 2021 doi:10.20944/preprints202103.0666.v1

1. Introduction:

Bricks is one of the most important construction materials. Bricks may be manufactured from clay, shale or combination of these materials [1]. Other materials such as Silica, Alumina, Lime, Iron oxide, Magnesia may be used for manufacturing good quality brick [2]. Depending on manufacturing process, uses, shape bricks can be classified as different types [4]. In this study some general types of bricks will be investigated with their technical specification including dimension, visual appearance, compressive strength, average water absorption (%), efflorescence characteristics and unit weight. On the basis of manufacturing & preparation burnt clay bricks can be classified as 1st class, 2nd class, 3rd class bricks. Based on constituent materials bricks can be classified as Common Burnt Clay Bricks, Sand Lime Bricks (Calcium Silicate Bricks), Engineering Bricks, Concrete Bricks, Fly ash Clay Bricks etc. [2].

To know the quality of bricks different tests are performed such as Compressive strength test, Water Absorption test, Efflorescence test, Visual appearance test etc. [2,5,9]. Water absorption results represents in percentages and for good quality value is less than 20% [4,11]. Larger compressive strength indicates higher stability, efflorescence test finds out the presence of alkalis which is very essential for building structures [2].

In this study all of these test results for several bricks collected and analyzed for final outcomes. Hope this study will be helpful for knowing some general types of bricks with their technical specification and create a new dimension for further brick quality investigation.

2. Materials and methods:

This study includes data collection, data rearrangement, analysis and final outcomes. The data were collected from several existing study [1, 3-14]. After collection, data were analyzed by MS Excel 2016 software. First general technical specification was identified, after that some plots were generated for comparative study among different bricks type. At the end of the study Bricks Quality Index (BQI) was evaluated to know the quality of several types of bricks.

For brick quality evaluation the steps were followed as bellow:

Preprints (www.preprints.org) | NOT PEER-REVIEWED | Posted: 26 March 2021 doi:10.20944/preprints202103.0666.v1

1. Rating the specification/ characteristics of bricks from 1 to 5. Where 1 for poor quality, 2 for slightly poor, 3 for moderate, 4 for good and 5 stands for excellent quality of bricks.
2. The rating is provided based on some general class. For example, first considering the value of compressive strength (kg/cm^2). According to this, bricks are classified as poor (which has 0-30 kg/cm^2 compressive strength), slightly poor (which has 31-75 kg/cm^2 compressive strength), moderate (which has 76-100 kg/cm^2 compressive strength), good (which has 101-140 kg/cm^2 compressive strength), excellent (which has >141 kg/cm^2 compressive strength). When bricks are classified as poor then rated it 1, rated 2 for slightly poor, rated 3 for moderate, 4 for good and 5 for excellent class of bricks.
3. Similarly, for water absorption (%), unit weight (kg/m^3) and efflorescence the bricks were classified as Table-1.

   Table-1: Classification of bricks based on different characteristics.

Water Absorption	Unit weight (kg/m^3)	Efflorescence
>25 poor	0-670 poor	Large: poor
22-25 slightly poor	671-1340 slightly poor	Little: slightly poor
20-22 moderate	1341-1680 moderate	Slight: moderate
16-19 good	1681-2000 good	Nil-slight: good
0-15 excellent	>2000 excellent	Nil: excellent

4. After that, all of rating value averaged to obtain the Brick Quality Index (BQI).
5. Based on BQI the bricks were identified as poor to excellent quality. Bricks were identified as poor when (0< BQI<2), bricks were specified as slightly poor when (2<BQI<3), moderate when (3<BQI<4), Good when (4< BQI<=4.5), better BQI (4.5< BQI<5), excellent BQI=5.

3. Results & Discussion:

3.1. General characteristics:

The general characteristics of several types of bricks displayed in Table-2. The table includes the visual appearance of bricks, dimension of bricks (Length, weight and height), water absorption rate (%), compressive strength (kg/cm^2), Efflorescence and unit weight (kg/m^3).

Preprints (www.preprints.org) | NOT PEER-REVIEWED | Posted: 26 March 2021 doi:10.20944/preprints202103.0666.v1

Table-2: General Characteristics of Bricks.

Types of Bricks	Image	Ave. Dimensions (+0.3/-0.3) (in cm) (L*W*H)	Appearance test (visual)	compressive strength (kg/cm2)	Ave. water absorption (%)	Efflorescence test (Tendency to efflorescence)	Ave. Dry oven weight (kg)	Ave. Wet weight (kg)	Unit weight (kg/m^3)
1st class bricks		24 x11.5 x7	Sound, hard, well burnt, uniform size, shape and color, homogeneous in texture	140-170	20% of dry weight	Nil	3- 3.5 kg	3.75-4.5 kg	2000
Picked jhama bricks		24 x11.5 x7	Over burnt 1st class brick	170-210	<15%	Nil	3- 3.5 kg	3.51-4.11 kg	2000
1st class machine made bricks		20 x 10 x 5	Rectangular faces with parallel sides and shape	210	10%	Nil	2.5- 3 kg	3.11 (average)	2800
Clinker Bricks		20.3 x10.2x5.1	Square, straight, sharply, shiny, dark-colored coating	562	12-15 %	Nil	3.1 kg	3.56 kg	1601-1794

Preprints (www.preprints.org) | NOT PEER-REVIEWED | Posted: 26 March 2021 doi:10.20944/preprints202103.0666.v1

Chamber clay bricks		20x 10 x 5	Reddish	80.86	10.54%	Nil- slight based on class	0.563	0.629	562.7
Fly-Ash Bricks		10.8 x 10.5 x 5.8	very attractive color like cement	97.93	13.52%	Slight	1.151	1.133	1805.5
Porothem Blocks		39.5 x 20 x15.2	Block color is Red	14.86	14%	slight	8.906	10.42	741.6
AAC Blocks		10.2 x 6.1 x6	Attractive Appearance (white)	33.55	59.68%	Nil	0.722	1.791	1885.6
CLC Blocks		20.4 x 10.3 x 5.3	Color like Cement.	25.44	8.72%	moderate	1.077	1.179	972.2
Concrete Brick		21.5 x 10.25 x6.5	Attractive Flat, smooth, sharp	Around 250	11.23%	slight	2.08 – 3.09	2.34 – 3.47	1450-2150
Common burnt clay bricks	 1st class	Standard size: 23* 11*7.6 cm	Red copper color, sharp edges and smooth surfaces	1st class: 109-350	<15%	Nil	Average Standard weight 3- 3.5 kg	3.75-4.5 kg	1600 - 1900 Kg/ m3
	 2nd class	modular(L *W*H): 19*9*9 or 19*9*4	Red, Irregular, sharp edges	2nd Class: 75	<20%	little			
		Non modular(L *W*H):	Red,	3rd Class:	<25%	large			1100

Preprints (www.preprints.org) | NOT PEER-REVIEWED | Posted: 26 March 2021 doi:10.20944/preprints202103.0666.v1

	3rd class	23*11*7 or 23*11*3	rough and have unfair edges	35-70					
Engineering bricks		24 x 12.1 x 6.98	Red/ Blue, smooth finish with perforations through the top to the bottom	Class A: >760 Class B: >1270	10%	Nil	3.2	3.5	1577
Calcium silicate bricks/ Sand lime bricks		25x12x8.8	Uniform color & texture	102	14%	Nil	2.64 – 5.8	3.07 – 6.74	1000 to 2200 kg/m3
Perforated Brick		20 x 10 x 5	Any regular shape in cross section	70-210	12%	Nil	2.8- 3.1 kg	3.2 – 3.52	2800

Preprints (www.preprints.org) | NOT PEER-REVIEWED | Posted: 26 March 2021 doi:10.20944/preprints202103.0666.v1

3.2 Comparison of different properties of Bricks

3.2.1 Average compressive strength of bricks type

Figure-1 represents the average compressive strength of several bricks. The outcomes clarify that engineering bricks have larger compressive strength than others. Clinker bricks have also larger compressive strength. In case of different blocks such as porothem blocks, AAC or CLC blocks compressive strength is lesser. The lower value indicates lower crushing strength that means lower pressure required to break the bricks. It also indicates lower stability of bricks.

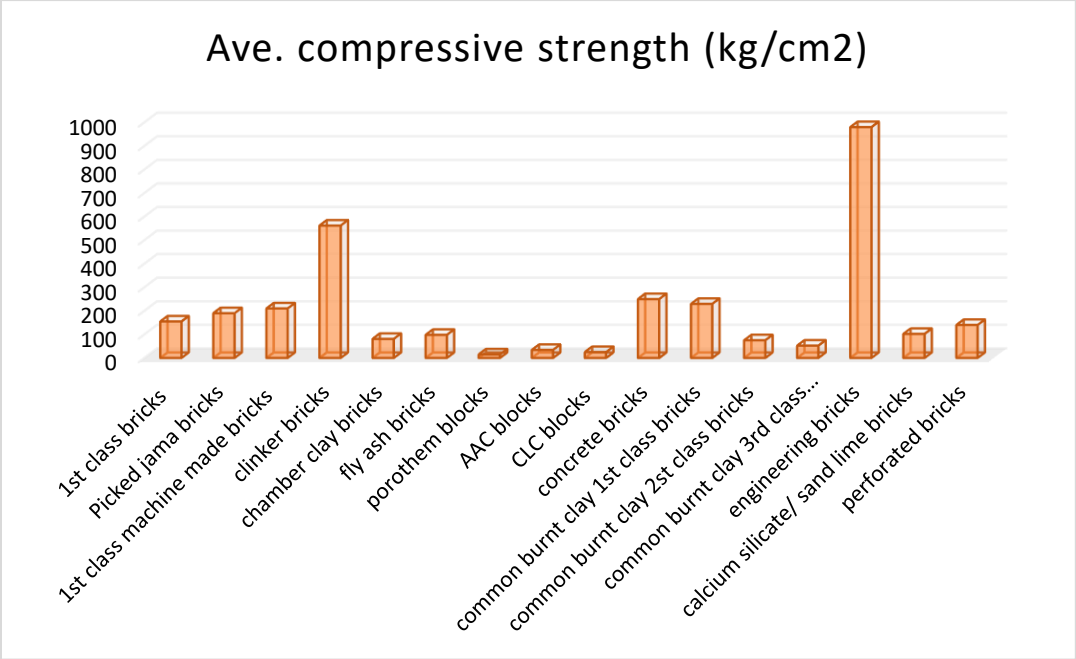

Figure-1: Average compressive strength of bricks type

3.2.2 Average water absorption rate of different bricks type

The water absorption test performed by weighting the bricks at dry condition and weighting these after 24 hours immerged in fresh water. The lower value of water absorption represents good quality. In reverse the higher value of water absorption represents poor quality. It can be noticed that the water absorption rate for 1st class bricks, engineering bricks and 1st class machine made bricks are low which clarify these are good quality bricks. In case of AAC blocks,2nd class or 3rd class bricks the water absorption rate is comparatively high which indicates the lesser quality. Figure-2 displayed the results.

Preprints (www.preprints.org) | NOT PEER-REVIEWED | Posted: 26 March 2021 doi:10.20944/preprints202103.0666.v1

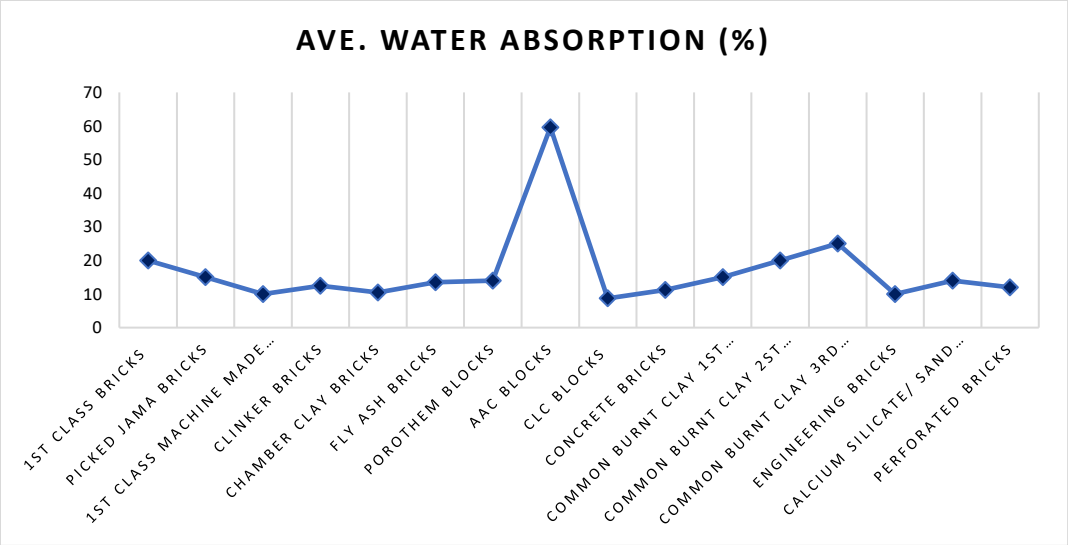

Figure-2: Average water absorption rate of different bricks type

3.2.3 Average unit weight of different bricks:

Unit weight represents the weight of any materials per unit volume. This weight help to evaluate the structure's weight, to specify the load which the structure of such materials can carry, to quantify amount of material required for specific space, to determine whether the materials will sink or float on water [10]. So, the unit weight of material is more important for any construction purpose. The figure-3 showed the unit weight of different types of bricks. The result clarifies that the unit weight of 1st class machine made bricks and perforated bricks are high on the other hand for chamber clay bricks this value is low.

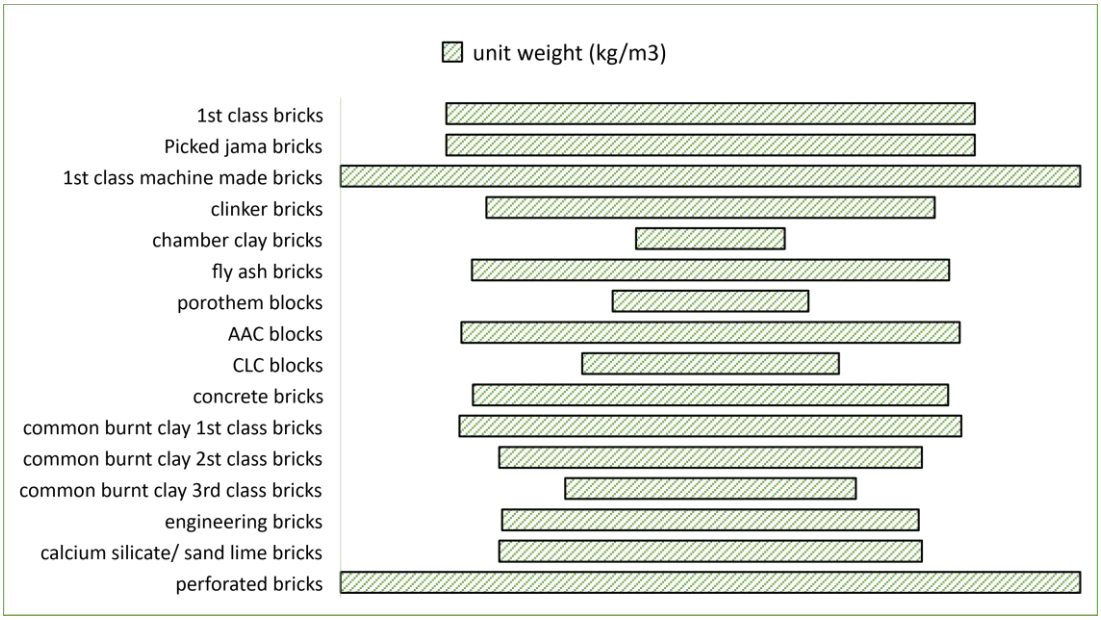

Figure-3: Average unit weight of different bricks

Preprints (www.preprints.org) | NOT PEER-REVIEWED | Posted: 26 March 2021 doi:10.20944/preprints202103.0666.v1

3.3 Bricks Quality Index Evaluation

The quality of different types of bricks displayed in Table-3. The results indicated that the quality of 1st class machine made bricks and engineering bricks are excellent. Clinker bricks, Picked Jama bricks are of better quality. The quality of 3rd class bricks poor. Slightly poor-quality construction materials are porothem blocks, CLC blocks, 2nd class bricks etc.

Table-3: Quality of different types of bricks.

Types of Bricks	Ave. compressive strength (kg/cm2)	unit weight (kg/m3)	Ave. water absorption (%)	Efflorescence	Bricks Quality Index (BQI)	Quality
1st class bricks	5	4	4	5	4.5	Good
Picked Jama bricks	5	5	4	5	4.75	Better
1st class machine made bricks	5	5	5	5	5	Excellent
clinker bricks	5	5	4	5	4.75	Better
chamber clay bricks	3	5	1	4	3.25	Moderate
fly ash bricks	3	5	4	3	3.75	Moderate
porothem blocks	1	5	2	3	2.75	Slightly poor
AAC blocks	2	1	4	5	3	moderate
CLC blocks	1	5	2	3	2.75	slightly poor
concrete bricks	5	5	4	3	4.25	good
common burnt clay 1st class bricks	5	5	4	5	4.75	Better
common burnt clay 2st class bricks	2	4	3	2	2.75	slightly poor
common burnt clay 3rd class bricks	2	2	2	1	1.75	poor
engineering bricks	5	5	5	5	5	Excellent
calcium silicate/ sand lime bricks	4	5	3	5	4.25	good
perforated bricks	4	5	5	5	4.75	Better

4. Conclusions:

- For compressive strength, it can be seen that engineering bricks and clinker bricks have high compressive strength. On the other hand, different types of blocks such as porothem blocks, AAC, CLC, and 3rd class bricks also have lower compressive strength.
- The good quality bricks have lower water absorption rate but poor-quality bricks have higher water absorption rate.
- For excellent or good quality bricks efflorescence is nil, compressive strength high, water absorption low and unit weight is also high.
- According to BQI 1st class machine made bricks & engineering bricks classified as excellent quality bricks, Picked Jama bricks, clinker bricks, common burnt 1st class bricks classified as better quality, concrete bricks, calcium silicate/ sand lime bricks classified as good quality bricks, 2nd class blocks, porothem blocks etc. classified as slightly poor and common clay burnt 3rd class bricks classified as poor-quality bricks.

References:

[1] Govt. of people republic of Bangladesh Report (2005) Technical specification for building, LGED & JICA, https://oldweb.lged.gov.bd/UploadedDocument/UnitPublication/4/12/2005_Technical%20Specifications%20for%20Buildings.pdf

[2] Lecture note on CIVIL ENGINEERING MATERIALS & CONSTRUCTION

COURSE CODE: BCE 203, http://vssut.ac.in/doc/civil-engineering-materials-construction-bce203.pdf

[3] Construct yourself, 2021, Building Materials, https://construct-yourself.com/building-materials-and-constructions/construction-materials/lime-brick-the-size-weight.html. Accessed on: 18.03.2021

[4] Civilsir, 2021, Bricks Types and Properties, https://civilsir.com/what-is-bricks-brick-types-and-properties-of-1st-class-brick/ Accessed on: 18.03.2021

[5] Izzati M Y N. et al, 2019, Strength and water absorption properties of lightweight concrete brick, IOP Conf. Ser.: Mater. Sci. Eng. 513 012005.

[6] Clinker Brick, Wikipedia, 2021, https://en.wikipedia.org/wiki/Clinker_brick . Accessed on: 18.03.2021

[7] Architecture and Design, 2021,Clinker Bricks, https://www.architectureanddesign.com.au/features/list/clinker-bricks-3-iconic-clinker-brick-houses. Accessed on: 19.03.2021

[8] The Constructor, 2021,Calcium Silicate Bricks, https://theconstructor.org/building/calcium-silicate-bricks-masonry-construction/17256/. Accessed on: 19.03.2021

[9] Mahendran, K., Sivaram, T., Shahulhameed, M., Logaraja, R., 2016, A Comparative Study on Various Building Blocks as An Alternative to Conventional Bricks, IJARSE, Vol-5, Issue-02.

[10] Centre for Science & Environment, 2018, Utilization Framework Fly-ash Products, https://cdn.cseindia.org/attachments/0.06164800_1533100874_Testing-of-flyash-brick-on-site.pdf

[11] Shukla R., 2014, Burnt Clay Bricks Versus Autoclaved Aerated Concrete Blocks A Comparative Analysis, International Journal of Engineering Research & Technology (IJERT), Vol. 3 Issue 11, November-2014

[12] Manodeepan, N et al., 2018, Experimental Investigation on Light Weight Brick with Foaming Agent, International Research Journal of Engineering and Technology (IRJET), Volume: 05 Issue: 03.

[13] Likestone, 2021, Engineering Bricks, https://likestone.ie/2018/08/23/purpose-and-specification-of-an-engineering-brick/ .Accessed on: 19.03.2021

[14] Civil Lead, 2020, Unit weight of Building Materials, https://www.civillead.com/unit-weight-of-buildingmaterials/#:~:text=The%20unit%20weight%20is%20essential%20for%20weight%20calculation%20purposes.&text=Unit%20weight%20of%20any%20material,sink%20or%20float%20on%20water. Accessed on 22.03.2021