BRICK RESIDUES AS AGGREGATE IN CONCRETE BLOCK

PSHTIWAN H. MAHMOOD

Brick Residues as Aggregate in Concrete Block

1. INTRODUCTION

Recycling and reuse of waste materials is an important process of global concern and, the urgent need for recycling is driven mainly by environmental considerations.

In this case, we have huge brick residues. We used Crushed Brick as Aggregate in concrete blocks instead of Gravel and part of Sand. In some countries after World War II, many buildings are constructed from crushed waste because of the need for low-cost and rapidly constructed Buildings and to clean the environment of excess materials.

Crushed brick can be useful for a variety of purposes, such as creating a base for a driveway or walkway, filling in low spots on a lawn, or as a decorative element for landscaping. It is an environmentally friendly option as it is made from recycled materials and it can also be used as a substitute for gravel or other traditional materials. In addition to these, brick has many other uses such as Backfilling, and aquarium filtration… some time used for Light Wight concrete.

Reusing construction materials can be a great way to reduce waste and save money on construction projects. Depending on the condition of the block, it may be possible to clean and repurpose them for a new project. Alternatively, broken or damaged blocks can often be crushed

and used as a base material for new construction projects or as a decorative element in landscaping.

Using crushed brick as an aggregate in concrete blocks can be a great way to create lightweight blocks with good insulation properties. The use of crushed brick in concrete blocks can improve thermal insulation, reduce the weight of the block, and add aesthetic value to the finished product.

We used crushed brick as an aggregate in our concrete block, we mixed it with cement and sand in the appropriate ratio. However, it is important to ensure that the crushed brick is free from debris, as this will affect the strength and durability of the concrete block.

In our research, we only use a Crusher, some simple equipment, and Sieve, we can produce Crushed Brick Blocks with Dimensions of 200*200*400 mm and we can also produce different sizes but we choose the above dimension Due to market influence.

2. Material Use:

1. Cement: Used Ordinary Portland Cement from a local Factory in Sulaymaniyah City.
2. Coarse Aggregate: Crushed Brick from Residues of Sirwan Brick Factory.
3. Fine Aggregate: same Crushed Brick from the Residues of Sirwan Brick Factory that is mixed with Crushed Brick.
4. Water: Clean water from our Field.
5. And crushed sand (0.5 mm – 2.5 mm)*.

* I used very coarse sand (0.5 mm – 2.5 mm) because our crushed brick contains fine aggregates, as I have shown below in the results of the sieve analysis.

3. Mix design and production of standard specimens:

3.1 First step preparing Brick residue for crushing and then testing of sieve analysis.

Our Field Test

Sieve Analysis for Crush Brick

Total Weight: 1034 grams

Sieve mm	Dry Sample Wt. gr		
	Retain gr	Retain %	%
> 25	0	0.00%	45.19%
> 19	11.8	1.14%	
> 12.5	31.1	3.01%	
> 9.5	116.1	11.23%	
> 4.75	308.3	29.82%	
> 2	248.5	24.03%	54.81%
> 0.4	194.1	18.77%	
> 0.25	39.4	3.81%	
> 0.063	57.1	5.52%	
> 0.04	13.4	1.30%	
< 0.04	10.5	1.02%	
		99.64%	

Project: تایبەت

Requested By: کۆمپانیای ڕووف / Let No. 23 On 29/07/2021

Contractor: کۆمپانیای ڕووف

Report No.: 3807 A

Date: 17/08/2021

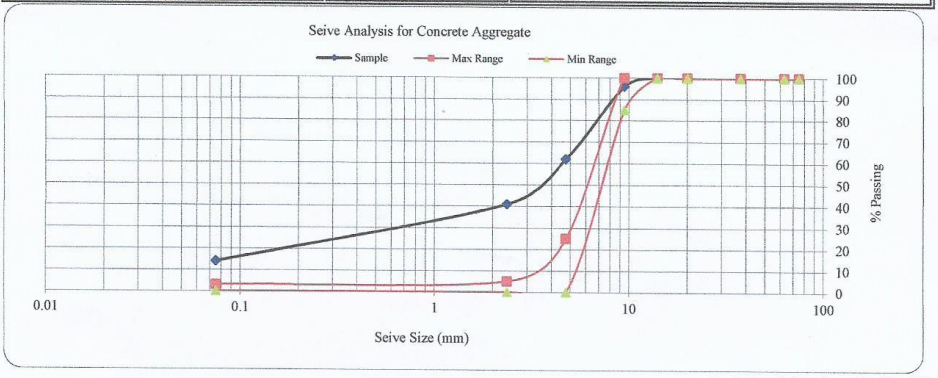
Aggregate From Natural Sources For Concrete

(الركام الخشن)ركام المصادر الطبيعية المستعمل في الخرسانة والبناء

(بموجب م.ق.ع 1984/45)

Sieve Analysis For Coarse Aggregate Single Size 10mm

Seive mm	Dry Sample Wt gm		3000	Single Size 10mm Specification Limits % Pass		Sample Type
	Cum. Retain gr	% Retain	% Passing	Min	Max	خشتی هاڕاو (بەکاردێت بۆ دروستکردنی بلۆك)
75	0	0	100	100	100	
63	0	0	100	100	100	
37.5	0	0	100	100	100	
20	0	0	100	100	100	
14	0	0	100	100	100	
9.5	114	4	96	85	100	
4.75	1141	38	62	0	25	
2.36	1784.5	59	41	0	5	
0.075	2575	86	14	0	3	



الملاحظات والتوصيات: (تێبینی وراسپاردن)

Manager

3.3 Starting mix design:

The first time, we used only:

-Crushed brick

-Cement

-Water

Trail #1

Symbol	No. of Sample	Crushed Brick by Wt. Kg	Cement Kg	Sand Kg	Date Of Casting	Date of Testing	Age of Sample (Days)	Compressive Strength Mpa	
								Without correction Mpa	With correction Mpa
A1	1	12.5	1.70	0	19-06-2022	18-07-22	29	2.72	
	2	12.5	1.70	0	19-06-2022	18-07-22	29	2.17	
	3	12.5	1.70	0	19-06-2022	18-07-22	29	2.12	
	4	12.5	1.70	0	19-06-2022	18-07-22	29	2.04	
	5	12.5	1.70	0	19-06-2022	18-07-22	29	2.03	
						Average		**2.22**	

The first test is appropriate for the partition wall. We still have some problems during production because it passes heavily through the mold and sticks to the mold wall, reducing production by 75%. This is not economical and wastes a lot of time. So we stopped this from the beginning.

We started our trailers by adding crushed sand into the mix design:

Determine the ratio: The first step is to determine the proper ratio of the components in the mixture. The ratio will depend on our specific project needs, but a common ratio is 1:4:4 (cement:sand: crushed brick).

Mix the components: Mix the cement, sand, and crushed brick together until the mixture is uniform. You can use a concrete mixer or mix by hand. In this case, we used a mixer.

Add water: Add water slowly while mixing until the mixture has the consistency of thick mud.

Fill the block molds: Fill the molds with the mixture, making sure to pack the mixture firmly into the corners and edges.

Allow the blocks to cure further: Let the blocks cure for an additional 7-14 days before using them for construction.

Adding sand into our mix design helps us:

1. Easy casting.
2. More compressive strength.
3. More durable.

According to the above procedure we started another mix trails:

Trail #2

Symbol	No. of Sample	Crushed Brick by Wt. Kg	Cement Kg	Sand Kg (Darband)	Weight (gm)	Dimension cm			Date Of Casting	Date of Testing	Age of Sample (Days)	Compressive Strength Mpa	
						L	W	H				Without correction Mpa	With correction Mpa
H1	1	7	2.10	7.5	1700	40	20	20	05-Jul-22	03-Aug-22	29	3.95	
	2	7	2.10	7.5	1755	40	20	20	05-Jul-22	03-Aug-22	29	5.01	
	3	7	2.10	7.5	1750	40	20	20	05-Jul-22	03-Aug-22	29	4.98	
	4	7	2.10	7.5	1730	40	20	20	05-Jul-22	03-Aug-22	29	4.18	
	5	7	2.10	7.5	1705	40	20	20	05-Jul-22	03-Aug-22	29	5.62	
	6	7	2.10	7.5	1670	40	20	20	05-Jul-22	03-Aug-22	29	4.44	
	7	7	2.10	7.5	1740	40	20	20	05-Jul-22	03-Aug-22	29	5.51	
	8	7	2.10	7.5	1730	40	20	20	05-Jul-22	03-Aug-22	29	4.61	
	9	7	2.10	7.5	1720	40	20	20	05-Jul-22	03-Aug-22	29	5.45	
					1722					Average		**4.86**	

Just by adding river sand and increasing cement from 1.7 kg to 2.10 kg, we have a good result from a 2.2 Mpa increase to 4.86 Mpa.

According to Iraqi specifications, we do not have specifications for the Crushed Brick blocks Test. Therefore, we are compelled that our Specimens test compared with Concrete Masonry Units.

According to Iraqi specifications (1077/1987) for Load-Bearing Masonry Units, we have two types:

Category

Grade (A): for general use in internal or external walls exposed to moisture or climatic influences under or above ground level.

Grade (B): For use above ground level in interior or exterior walls that are protected from access humidity or climatic influences.

For Grade A:

The minimum Average Compressive strength is 7 Mpa and a single specimen is a minimum of 6 Mpa.

For Grade B:

The minimum Average Compressive strength is 5 Mpa and a single specimen is a minimum of 4.5 Mpa.

We are currently approaching Grade B, but we are trying more.

Trail #3

Symbol	No. of Sample	Crushed Brick by Wt. Kg	Crushed Brick by Ltr.	Cement Kg	Sand Kg (Crushed)	Sand By Ltr (Crushed)	Date Of Casting	Date of Testing	Age of Sample (Days)	Compressive Strength Mpa	
										Without correction Mpa	With correction Mpa
L1	1	8	7.5	2.300	4.5	4.5	8/8/2022	7/9/2022	30	5.67	
	2	8	7.5	2.300	4.5	4.5	8/8/2022	7/9/2022	30	5.45	
	3	8	7.5	2.300	4.5	4.5	8/8/2022	7/9/2022	30	4.81	
	4	8	7.5	2.300	4.5	4.5	8/8/2022	7/9/2022	30	6.47	
	5	8	7.5	2.300	4.5	4.5	8/8/2022	7/9/2022	30	5.33	
	6	8	7.5	2.300	4.5	4.5	8/8/2022	7/9/2022	30	4.88	
								Average		5.44	

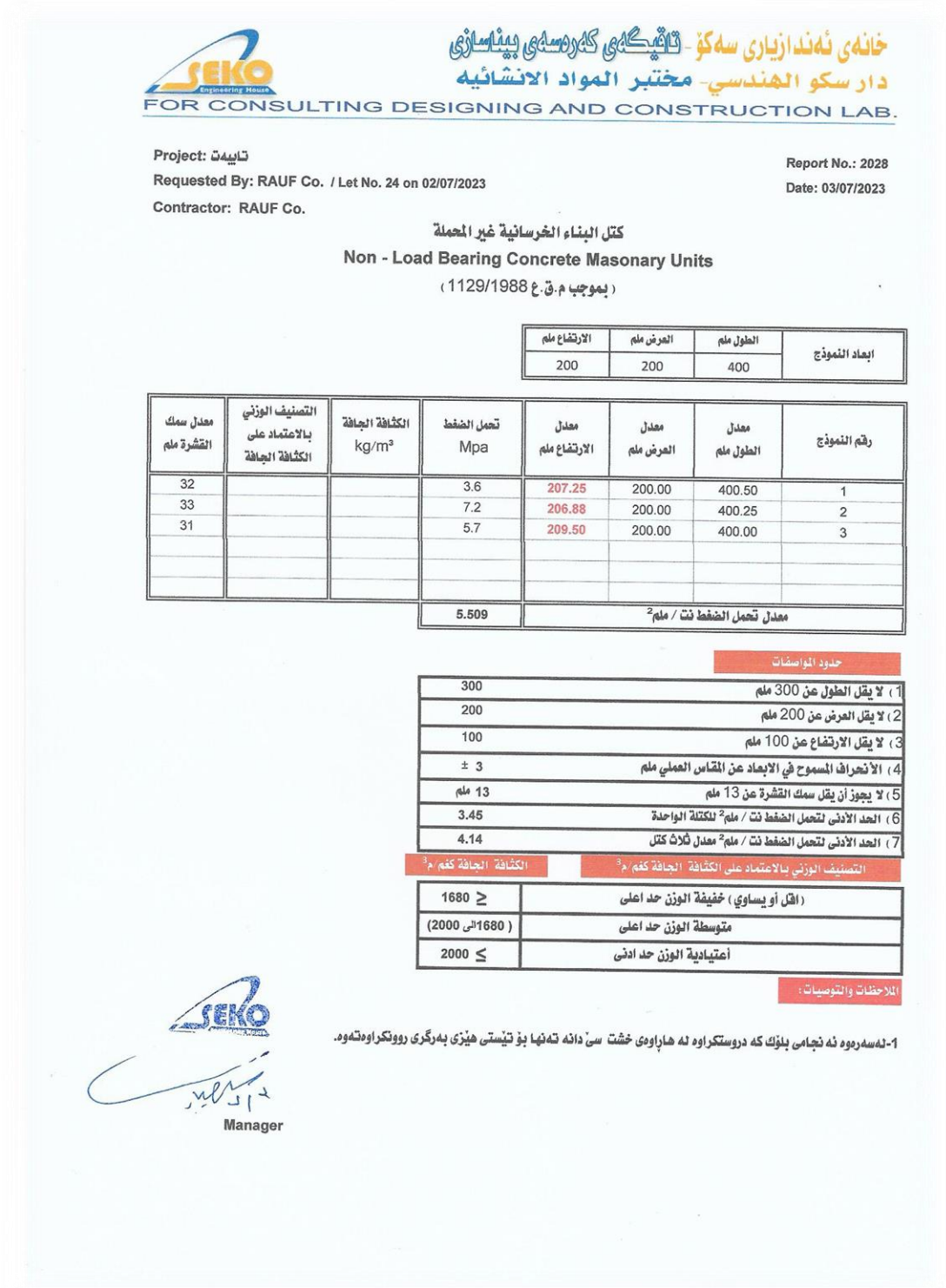
In this trail we happily reached Grade B According to Iraqi specifications (1077/1987) for Load-Bearing Masonry Units. We can use this product above ground level in interior or exterior walls that are protected from access humidity or climatic influences.

Trail #4

Symbol	No. of Sample	Crushed Brick by Wt. Kg	Crushed Brick by Ltr.	Cement Kg	Sand Kg (Crushed)	Sand By Ltr. (Crushed)	Weight (gm)	Date Of Casting	Date of Testing	Age of Sample (Days)	Compressive Strength Mpa	
											Without correction Mpa	With correction Mpa
L2	1	8	7.5	2.300	5	3.5	16.5	10/9/2022	9/10/2022	29	5.77	
	2	8	7.5	2.300	5	3.5	15.9	10/9/2022	9/10/2022	29	6.94	
	3	8	7.5	2.300	5	3.5	15.75	10/9/2022	9/10/2022	29	6.43	
	4	8	7.5	2.300	5	3.5	15.8	10/9/2022	9/10/2022	29	6.17	
	5	8	7.5	2.300	5	3.5	16.15	10/9/2022	9/10/2022	29	6.44	
	6	8	7.5	2.300	5	3.5	16.45	10/9/2022	9/10/2022	29	6.72	
							16.09		Average		**6.41**	

In this case, we were able to reach a Grade B According to Iraqi specifications (1077/1987) for Load-Bearing Masonry Units but safer than above (trail No.3) by adding a small amount of crushed sand.

We took a 3 specimen of the product and tested it in a professional lab to ensure the result.



خانەی ئەندازیاری سەکۆ - تاقیگەی کەرەسەی پیناسازی
دار سكو الهندسي- مختبر المواد الانشائيه
FOR CONSULTING DESIGNING AND CONSTRUCTION LAB.

Project: تاییەت
Requested By: RAUF Co. / Let No. 24 on 02/07/2023
Contractor: RAUF Co.

Report No.: 2028
Date: 03/07/2023

كتل البناء الخرسانية غير المحملة
Non - Load Bearing Concrete Masonary Units
(بموجب م.ق.ع 1129/1988)

ابعاد النموذج	الطول ملم	العرض ملم	الارتفاع ملم
	400	200	200

رقم النموذج	معدل الطول ملم	معدل العرض ملم	معدل الارتفاع ملم	تحمل الضغط Mpa	الكثافة الجافة kg/m³	التصنيف الوزني بالاعتماد على الكثافة الجافة	معدل سمك القشرة ملم
1	400.50	200.00	207.25	3.6			32
2	400.25	200.00	206.88	7.2			33
3	400.00	200.00	209.50	5.7			31
معدل تحمل الضغط نت / ملم²				5.509			

حدود المواصفات

1) لا يقل الطول عن 300 ملم	300
2) لا يقل العرض عن 200 ملم	200
3) لا يقل الارتفاع عن 100 ملم	100
4) الأنحراف المسموح في الابعاد عن المقاس العملي ملم	± 3
5) لا يجوز أن يقل سمك القشرة عن 13 ملم	13 ملم
6) الحد الأدنى لتحمل الضغط نت / ملم² للكتلة الواحدة	3.45
7) الحد الأدنى لتحمل الضغط نت / ملم² معدل ثلاث كتل	4.14

التصنيف الوزني بالاعتماد على الكثافة الجافة كغم/م³	الكثافة الجافة كغم/م³
(اقل أو يساوي) خفيفة الوزن حد اعلى	≥ 1680
متوسطة الوزن حد اعلى	(1680الى 2000)
أعتيادية الوزن حد ادنى	≤ 2000

الملاحظات والتوصيات:

1-لەسەرەوە نە نجامی بلۆك كە دروستكراوە لە هاوەی خشت سێ دانە تەنها بۆ تێستی هێزی بەرگری روونكراوەتەوە.

Manager

According to above result;

By average it is passed but one of our specimens result lower than Iraqi specification for masonry concrete block.

We can redesign for two or more storey building and create a custom specification for our product, we can easily use it as Grade B for two or more storey building. Like the new products on the market because our products are new and not mentioned in the Iraqi specifications.

On the other hand;

Our product certainly can use for partition wall (Non-Load bearing) and we have two case for using in a partition wall:

1. If we use instead of Ponza Block we can depend on Trial No.2.
2. If we use instead of Iraqi concrete block for Partition (Non-Load bearing) we can depend on Trial No. 3 or 4.

I suggest to design a special specification for our product because it is useful to recycle all the brick waste from all the brick factories in Iraq which is the reason to protect our environment and more sustainable.

Advantage and conclusion

1. The advantage of recycling brick waste is that it helps to reduce the demand for new bricks, which in turn conserves natural resources such as clay and sand.
2. Recycling brick waste also reduces the amount of waste sent to landfills, helping to reduce the impact on the environment.
3. Additionally, brick recycling can save energy and reduce greenhouse gas emissions compared to producing new bricks.
4. Crushed brick can enhance the thermal properties of concrete blocks. The porous nature of crushed brick allows for better insulation, helping to regulate temperature and reduce energy consumption for heating and cooling.
5. Using crushed brick in concrete blocks can contribute to sustainable construction practices by diverting waste from landfills and promoting the reuse of materials. This helps reduce the environmental impact associated with traditional construction materials.
6. incorporating crushed brick into concrete blocks can improve their durability.
7. Light weight according to concrete block by %25 to %35.

Sampple of our product:

Reference:

1. American Society for Testing and Materials ASTM.
2. IS: 10262-2009, Recommend Guidelines for Concrete Mix Design, Bureau of Indian Standards, New Delhi.
3. Use Of Crushed Bricks As Coarse Aggregate In Concrete Fadia S. Kallak, Assistant Lecturer Civil Eng. Dept.-University of Tikrit.
4. The Effect of Capping Condition on the Compressive Strength of Concrete Hollow Blocks, An-Najah Univ. J. Res. (N. Sc), Vol. 17(1), 2003
5. Concrete technology by M.S. Shetty, S. Chand.