Use of Broken Solid Waste as an Adulterant in Concrete: A Review

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Abstract— At this time India is a fastest growing country in the world. In a developing nation the prime requirement is the infrastructure for the industries and offices. Any kind of infrastructure development the basic requirement is the Coarse Aggregate, fine aggregate, cement and water. Aggregate is the natural resource and it is rapidly decreasing due to overexploitation. There has the substitute of aggregate which fulfill the high demand of aggregate. Broken solid waste has fulfilled the aggregate demand in concrete structures. Due to increasing urbanization and modernization demolish the existing building and rapidly build the good looking and attractive houses and building for living and other purposes. Fortunately broken solid waste is freely and easily available around us, and Broken Solid Waste is used as an adulterant in concrete. In concrete construction aggregate partially or fully replaced with broken solid waste. In some constituents of broken solid waste is give more strength than aggregate, like granite and marble are given high strength than aggregate so it has to be fully replace with broken solid waste.

Keywords: Broken solid waste, Aggregate, Concrete, C & D waste etc

I. INTRODUCTION

Aggregate is the prime requirement of the concrete, it act as an adulterant in concrete. It is inert in nature, hard and durable in compressive load. Locally aggregate has available in economic rate and good quality, due to this demand of aggregate is too much high. Aggregate resource has overexploited due to great demand and rapidly diminishing in nature due to limited quantity. In developing countries prime requirement is the infrastructure and machineries. The demand of the infrastructure is from industrial, commercial and residential sectors, and increasing building in any country is the sign of developing country, because development of buildings in developing countries is more than the developed countries. Demolished waste handling and disposal is the major problem in the developing countries, and improper disposal causes leaching and loss of fertility of soil. Demolished waste is the heterogeneous waste, it is contains lots of waste which may or may not be inert, i.e. some material may be chemically and biologically active or not. But the broken solid waste (BSW) is impervious, non biodegradable and chemically inactive inert material like granite, marble, over burned bricks, tiles etc. There is necessary to preserve the natural aggregate by using BSW material.

BSW is inert in nature and perfectly replaced with natural aggregate and it is separated from the demolished waste. It is contains some special type inert waste that has to give more strength as compare to natural aggregate.

A. Scenario of Demolished waste

A report published by the CPCB, which interpret the demolition waste generation scenario. As discussed in above the demolished waste is heterogeneous waste, in the report also mansion that the uncertainty of demolished waste. It is interpret on average about 30% of all solid waste generate in city or town.

Amount of genesis of demolished waste estimates 10 MT -15 MT (million tonnes) per year by MoUD (2000), 12 MT - 15 MT by TIFAC (2001), 10 MT -12 MT by MoEF (2010), 12 MT by CPCB , 165-175 MT per annum during 2005-2013 (BMTC). According to International Society of Waste Management, India predict the genesis of demolished waste in India, estimated about 23.75 million tons annually and these digits are likely to double fold up to 2016.

The thumb rule for estimate the demolished waste for India given by Technology Information, Forecasting and Assessment Council's (TIFAC) are as follows:

1) Range 40-60 kg per m2 of new construction,
2) Range 40-50 kg per m2 of building repair
3) Range 300-500 kg per m2 for demolition of buildings.

The above point interpret the new building, maintenance and repair create less demolished waste as compare to complete demolition of building.

World is presently producing about 1.6 million tons of demolished waste and further this amount is continuously increasing. Construction industry is having a major role in the development and growth of a country. In future, its share will be increased to 70 to 80 percent. Construction industry holds a total 14 to 15 % of total Gross Domestic Product (GDP). Yet, no disposal method is being practiced in 71 % of the industry because of the easy availability of the raw materials.

Demolish waste is consists of 30% of brick masonry waste, 35% of soil, sand, gravel, 25% of concrete and BSW, 5% of steel, 4% of bitumen, timber and 1% of glass with other inert material shows in figure 1.

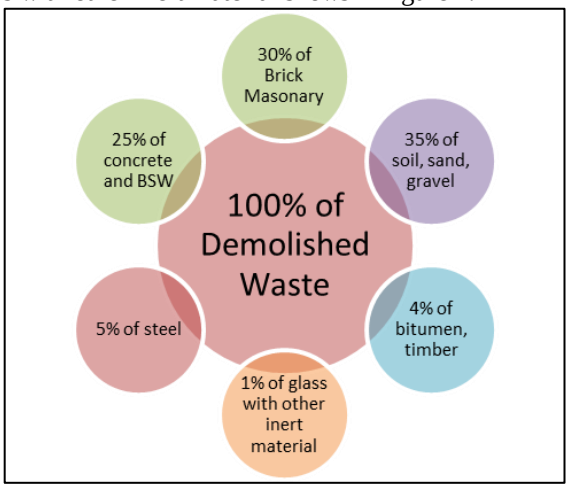

Fig. 1: Separation of C&D Waste

This review paper is contains the information related to waste inert solid materials and these information collected from different sources such as research papers, journals, magazines and websites. In this review paper we tried to collect much information related to waste inert solids materials from already published article.

II. SIGNIFICANCE OF STUDY

In this study we are trying to focus on the very special type of inert material which their property was not properly utilized in demolished waste. In some extent demolished waste is contain some corrosive and biodegradable matter which badly affect the strength of concrete. If the presence of carbonic matter in the concrete, there is not any problem during construction but within or after one month, organic matter will get decomposed biologically. Due to this decomposed organic matter in concrete forms cavity or became pores in concrete, i.e. loss of strength.

BSW is pure inert matter, which is segregated from the demolished waste. It is a highly impervious highly impervious and free from any kind of organic pollution.

III. LITERATURE REVIEW

M.N.Hiramath, Dr. Sanjay S J, Ms. Poornima D, have studied on Replacement of natural aggregate by Demolished brick waste in concrete. They have been detail discuss about the demolished waste and its physical properties with proper mix proportions. The volumetric replacement (0%, 25%, 50%, 75% and 100%) of aggregate by demolished brick waste. They have performed the laboratory test on demolished brick waste and analyzed the test results in graphical and tabulated view. They have conduct the various laboratory test such as specific gravity, impact test, water absorption, angularity number on demolished brick waste. They have found that 25% of replacement is demolished brick waste is considered as the best in view of economy and strength.

M. Saravanan, N. Vijay, R. Shakthi Daswanth, T. Jeeva, P. Karthick, have studied on Experimental study of concrete by partial replacement of coarse aggregate and fine aggregate replaced with Demolished concrete waste. They have studies the physical properties of demolished waste and also replace with aggregate using M25 grade concrete. In these studies volumetric replacement of (10%, 20% and 50%) of exiting natural aggregate with demolished waste. They have casted the sample cubes, beam and cylinder and tested the physical and mechanical properties. The sample are tested for, compressive strength, flexural strength, density and splitting tensile, for 7 and 28 days and compared with conventional concrete sample.

Ashwini Manjunath B T has studied on E- waste Partially replaced wth coarse aggregate in concrete. They has replace the fine aggregate and coarse aggregate with E-waste particles in various mix proportion about 0%, 20% and 30% considered for M20 concrete. They has perform various laboratory test on fine aggregate, coarse aggregate and E- waste, found that E- plastic material in mix gives stability and compressive strength of 53 grade of cement is very good.

Nikita Patel, Piyush Patel have studied on Use of Demolished Concrete Materials in Concrete and Comparative Study of its Mechanical Properties: NDT Comparison . They have replace the 50 % natural aggregate with recycled concrete aggregate for M20 concrete with 0%, 25%, 50%, 75%, and 100% mix proportion and found that in 50% mix proportion gives more strength as compare to 100% use of natural aggregate.

Youyun Li, Hui Zhou, Linjian Su, Hang Hou, and Li Dang have studied on Investigation into the Application of Construction and Demolition Waste in Urban Roads. They have interpreted the C&D waste is gives high strength and significant stability after simple treatment. They have done the laboratory and field test like compaction test, UCS, CBR and deflection check etc.

Kuldeepak dwivedi has studied on Study On Properties of Concrete Using Overburent Brick Chips and Demolished Concrete Waste As Partial Replacement Of Coarse Aggregate. They have utilized the over burned brick chips and C&D waste in 10% to 50% and found that the 25% replacement of over burned brick chips and 35% replacement of C&D waste gives strength near about M25 grade concrete.

IV. MATERIAL USED

A. Broken Solid Waste(BSW):

BSW is defined as the highly impervious and relatively hard and tough material, which is inert in nature. Ex, Granite piece, Marble piece, Quartzites, Amphibolites, Over Burned Bricks, Tiles, etc.

1) Granite Piece:

Granite is a plutonic igneous rocks equigranular texture. It is composed of feldspar, orthoclase, abundant in excess amount of plagioclase feldspar, biotite mica and iron pyrites. It is most popular rock and widely used in building for aesthetic purposes. It is an excellent structural integrity i.e. each and every molecules of granite highly packed and forms impervious stones. It is most widely used in construction works like beams, stairs, pillars, kerbs, slab, foundation wall, bridges, retaining wall, rubble masonry, monuments and memorial stones etc.

Fig. 2: Granite waste (Flickr)

2) Marble Piece:

Marble is a metamorphic rocks formed by recrystallization of limestone resulted from the underground excess heat of igneous rocks and pressure. Pure lime is white in colour but

due some impurities in limestone, it is found in variety of pleasing colours like pink, brown, grey, green and greenish black and black. Marble is also widely used for decorative and aesthetic appearance in different components of building. It is used for exterior and interior decoration, inscription stones, tombstones, memorial stones, kitchen, table, flooring etc.

Fig. 3: Marble waste

3) Quartzites:

In this rock quartz is the major mineral constitutes like as granite, quartz grains appears grayish white, transluscent glassy blebs, resinous luster, hard and angular in shape. It is widely used in road and railway ballast. Quartzites is using in different decorative purposes like flooring, roofing, cover wall and slab of kitchen.

Fig. 4: Quartzite waste (Bosnia-quartz)

4) Amphibolites:

it is metamorphic rocks predominantly composed of amphiboles and plagioclase feldspar minerals. It is very dark and heavy due to which widely used in construction industries, roads and railways. It may be used in roofing, and flooring in building but requires high polish. At some places, it is sold as name of Black Granite.

Fig. 5: Amphibolites waste (Sandatlas)

5) Over Burned Bricks:

It is composed due to over burning of raw (unburned) bricks. Due to over burning of raw bricks alumina, silica, iron oxide, manganese molecules highly fused with lime and form relatively impervious and integrated brick. During over burning the shape and size of brick is disturbed. It is widely not used in the building construction due its irregular shape and dark colour. In concrete work over burned bricks can be used after break into small angular pieces.

Fig. 6: Over Burned Bricks (The constructor)

6) Tiles:

The hard wearing material used for manufacturing of tiles such as clay, ceramics, stones, even glass and metals. It is used for flooring and other decorative and aesthetic purposes in building. Broken tiles in not used in construction, it is discarded from the batch of tiles. It is also used in concrete work after break into small pieces.

Fig. 7: Tile waste (Stone world magazine)

V. General Properties of Materials

The general properties of material is shown in Table-1

Materials / Property	Fresh Aggregate	Granite	Marble	Quartzite	Over Burned Brick	Amphibolites	Tiles
Specific Gravity	2.5-3.1	2.7-2.8	2.4-2.7	2.65	1.75	2.7-3.6	2.2-3.1
Crushing (%)	10.2-12.9	22.3-28.4	20-30	17.3-32.2	22.7-26	20-30	12-15
Impact (%)	15-20	22.1-26	20-23	15-36	25-28	18-25	20-25
Absorption (%)	0.25	<0.1	0.05	0.31-1.19	10-15	<0.5	4.0-7.0
Porosity (%)	0.5-1.5	0.1-1.0	0.1-1.2	≈ 1.5	4.0-10	1.5-3.2	3.0-5.0
Abrasion (%)	30-39	10-15	15-22	20-35	……..	25-32	……..

Table 1: General Properties of Materials

VI. Conclusion

In this review paper the physical properties values of Broken Solid Waste (BSW) is much better than natural aggregate. In this literature highly focus on the effective utilization of BSW. From the environmental point of view, its use in construction industries, save maximum land space and minimum reduction of soil fertility. From an economical and technical point of view, its reducing construction cost without compromising of strength.

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