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Test study on hydration temperature of compound concrete made of demolished concrete lumps and fresh concrete

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Abstract

Twelve 300 mm cubes and four 1000 mm cubes made of demolished concrete lumps (DCLs) and fresh self-compacting concrete (FSCC) were manufactured, and hydration temperatures of these cubes were measured during the first seven days after casting. The influence of replacement ratio of DCLs (0, 20%, 25%, and 30%) on hydration temperature of the compound concrete containing DCLs is examined. It is found that the using of DCLs is an effective way to reduce the hydration temperature in concrete mix, and such temperature decreases gradually with the increasing of the replacement ratio; the maximum hydration temperature of the 1000 mm cube with a replacement ratio of 30% is only 84.5% of that of the 1000 mm cube made of FSCC alone.

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Keywords: demolished concrete lumps (DCLs); hydration temperature; replacement ratio of DCLs

1. Introduction

Recycling and reusing of waste concrete has been a global focus of research in recent years, and is motivated by the increasing severity of environmental degradation and resource depletion. Nowadays, landfill is the main way to deal with large amount of waste concrete, which causes some negative influences on the environment. Recycled aggregate concrete is another effective way to cope with waste concrete, but energy- and time-consumption in the

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production of recycled aggregates are great, meanwhile the amount of fresh cement employed in recycled aggregate concrete cannot be reduced, as compared with natural aggregate concrete. Different from the aforementioned practices, demolished concrete lumps (DCLs) with distinctly larger size (e.g., 60 mm~300 mm) than recycled aggregates have been directly employed in structural members by the authors [1-3], and mechanical properties of the compound concrete made of DCLs and fresh concrete have been experimentally investigated in the past several years [4-6]. Obviously, manufacturing process of DCLs is simpler than that of coarse and fine recycled aggregates, resulting in less energy and time consumption. On the other hand, a great deal of old cement in DCLs can be reused in the compound concrete.

Hydration of mass concrete usually generates a lot of heat, which causes concrete cracking seriously. Because reusing of DCLs not only reduces the amount of fresh cement in the compound concrete, but also absorbs some hydration heat, it is possible to reduce the hydration temperature in mass concrete by using of DCLs. The purpose of this study is to experimentally verify this issue.

2. Experiment program

2.1 Preparation of specimens

Nine 300 mm cubes and three 1000 mm cubes made of DCLs and fresh self-compacting concrete (FSCC) were prepared, meanwhile three 300 mm cubes and one 1000 mm cube made of FSCC alone were cast as reference specimens. Three values (20%, 25%, and 30%) are considered for the replacement ratio of DCLs (i.e., a ratio of the weight of DCLs to the total weight of specimen). Details of the specimens are listed in Table 1.

Table 1 Parameters of specimens

Notation	Length of cube / mm	Replacement ratio of DCLs (η)	Number of specimens
CU300	300	0	3
CU300-0.2	300	20%	3
CU300-0.25	300	25%	3
CU300-0.3	300	30%	3
CU1000	1000	0	1
CU1000-0.2	1000	20%	1
CU1000-0.25	1000	25%	1
CU1000-0.3	1000	30%	1

DCLs with a characteristic size of 100 mm~120 mm (Fig. 1) were made by breaking two waste support beams, which were obtained from a demolition site in Guangzhou city, into lumps. Cylinders with a diameter of 80 mm and a height of 80 mm were drilled from the waste beams, and were axially loaded to obtain the compressive strength of the waste concrete. The equivalent 150 mm cubic compressive strength of DCLs was 41.0 MPa. FSCC was from a same batch of commercial self-compacting concrete, and its mix proportion is shown in Table 2.

Fig. 1 Demolished concrete lumps (DCLs)

Table 2 Mix proportion of fresh self-compacting concrete (FSCC)

Material / ($kg \cdot m^{-3}$)					
Water	Cement	Sand	Coarse aggregate	Fly ash	Water reducer
173	355	685	1027	110	6.04

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