

Table1. Material properties

Materials	Properties
Ordinary Portland cement	Density: 3.15g/cm ³ ; Specific surface area: 360 m ² /kg
Granite powder (GP)	Specific surface area: 20000 m ² /kg; Particle size: 0~20.23μm
Limestone powder (LP)	Specific surface area: 800 m ² /kg; Particle size: 0~15μm
Coarse aggregate	Grading: 5~20mm
Fine aggregate	Grading: 0~4.75mm
Water	Tap water
Water-reducing agent	Water reducing rate: 20%

Table2. Main chemical composition of cement, granite, and limestone powders (%).

Material	CaO	SiO ₂	Al ₂ O ₃	Fe ₂ O ₃	MgO	SO ₃	MnO	Other
Cement	65.37	21.22	2.53	3.09	2.39	1.91	—	3.49
Granite powder	9.75	64.67	15.31	3.38	1.47	—	—	5.42
Limestone powder	95.33	1.11	0.31	0.82	0.33	—	—	2.10

Table 3. The mix proportions (unit weight, kg/m³).

Symbol	W/C	W	C	GP	LP	S	A	Ads
C	0.48	144	300	—	—	639	1296	3
G1	0.48	144	270	30	—	639	1296	3
G2	0.48	144	255	30	15	639	1296	3
G3	0.48	144	240	30	30	639	1296	3
G4	0.48	144	225	30	45	639	1296	3
G5	0.48	144	210	30	60	639	1296	3

(W: water, C: cement, GP: granite powder, LP: limestone powder, S: fine aggregate, A: coarse aggregate).