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ORIGINAL ARTICLE

Carbon emission measurement and reduction analysis of typical campus buildings using building information modeling and life cycle assessment

Supplementary Files

Table S1. Results of carbon emission calculation for the building material transportation stage

Types of building materials	Transportation mode	Transportation factor (tCO_2e/[t×km])	Transportation distance (km)	Carbon emission (tCO_2e)
Steel bars	2t light-duty gasoline truck	3.34×10^{-4}	500.00	69.64
Concrete		3.34×10^{-4}	40.00	63.73
Cement mortar		3.34×10^{-4}	500.00	206.47
Autoclaved aerated concrete blocks (B07)		3.34×10^{-4}	500.00	175.82
Rock wool boards		3.34×10^{-4}	500.00	2.78
Thermal insulation metal-profile multi-cavity frames		3.34×10^{-4}	500.00	11.16
6 mm transparent +12 mm air +6 mm transparent		3.34×10^{-4}	500.00	7.09
Wood (plastic) frame single-layer solid doors		3.34×10^{-4}	500.00	16.22
Fine stone concrete		3.34×10^{-4}	40.00	7.42
Extruded polystyrene foam boards		3.34×10^{-4}	500.00	1.02
Lightweight aggregate concrete (for ramming)		3.34×10^{-4}	40.00	1.98
Compacted clay (ρ=1,800)		3.34×10^{-4}	500.00	159.25
Total	-	-	-	722.57

Table S2. Results of carbon emission calculation for the building materials recycling stage

Types of building materials	Recyclability rate	Recycling factor (tCO_2e/unit)	Transportation mode	Transportation factor (tCO_2e/[t×km])	Carbon emission (tCO_2e)
Steel bars	0.90	1.967709	2t light-duty gasoline truck	0.000334	737.23
Concrete	0.70	0.014984		0.000334	8.09
Cement mortar	-	-		0.000334	-
Autoclaved aerated concrete blocks (B07)	0.70	0.207745		0.000334	216.26
Rock wool boards	-	-		0.000334	-
Thermal insulation metal-profile multi-cavity frames	0.80	0.059797		0.000334	16.74
6 mm transparent+12 mm air+6 mm transparent	-	-		0.000334	-
Wood (plastic) frame single-layer solid doors	0.80	0.059797		0.000334	24.32
Fine stone concrete	0.70	0.014984		0.000334	1.03
Extruded polystyrene foam boards	-	-		0.000334	-
Lightweight aggregate concrete (for ramming)	0.70	0.006400		0.000334	0.32
Compacted clay (ρ=1,800)	-	-		0.000334	-
Total	-	-	-	-	1,003.98

Note: The transportation distance was calculated as 10 km.

Table S3. Energy consumption during the construction stage

Construction machinery	Specification	Energy consumption per machine shift	Energy consumption per machine shift	Energy consumption of construction machinery
Mortar mixer	Mixing barrel capacity: 200 L	8.60 kWh/machine shift	7.34	63.03 kWh
Electrode drying oven	Capacity: 453, 545 cm^3	6.70 kWh/machine shift	9.67	64.77 kWh
Truck-mounted crane	Lifting capacity: 12 t	30.60 kg diesel/machine shift	12.077	369.56 kg diesel
Tapered thread lathe	Diameter: 45 mm	9.20 kWh/machine shift	85.50	786.60 kWh
Electric air compressor	Exhaust volume: 6 m^3/min	215.00 kWh/machine shift	407.10	87,505.70 kWh
Rubber-tired crane	Lifting capacity: 16 t	30.00 kg diesel/machine shift	12.18	365.4 kg diesel
Concrete troweling machine	Power: 5.5 kW	23.10 kWh/machine shift	14.34	331.24 kWh
Motorized dump truck	Loading capacity: 1 t	6.00 kg diesel/machine shift	131.262	787.57 kg diesel
Steel bar straightening machine	40 mm	30.00 kWh/machine shift	26.19	785.59 kWh
Dry-mixed mortar tank mixer	Nominal storage: 20,000 L	28.50 kWh/machine shift	44.29	1,262.13 kWh
Argon arc welder	Current: 500 A	70.70 kWh/machine shift	10.15	717.75 kWh
Butt welder	Capacity: 75 kV·A	122.00 kWh/machine shift	97.58	11,900.00kWh
DC arc welder	32 kV·A	100.00 kWh/machine shift	376.00	37,600.00 kWh
Metal surface polishing machine	Metal surface polishing machine	0.00 kWh/machine shift	10.15	0.00 kWh
Plate cutting machine	Plate width: 1,300 mm	0.00 kWh/machine shift	20.53	0.00 kWh
Spot welder	Capacity: 75 kV·A	154.60 kWh/machine shift	0.35	53.94 kWh
Steel bar bending machine	Diameter: 40 mm	12.80 kWh/machine shift	61.59	788.36 kWh
Pipe cutting machine	Pipe diameter: 150 mm	12.90 kWh/machine shift	16.92	218.27 kWh
Steel bar cutting machine	Diameter: 40 mm	32.10 kWh/machine shift	27.51	883.07 kWh

Table S4. Energy consumption of measure items

Construction machinery	Specification	Energy consumption per machine shift	Energy consumption per machine shift	Energy consumption of construction machinery
Single-cage construction elevator	Lifting capacity: 1 t; lifting height: 75 m	42.30 kWh/machine shift	941.98	39,845.05 kWh
Electric rammer	Ramming energy: 250 N·m	16.60 kWh/machine shift	1.698	27.71 kWh
Self-climbing tower crane	Lifting capacity: 400 t	164.30 kWh/machine shift	1,130.53	185,758.57 kWh
Steel bar bending machine	Diameter: 40 mm	12.80 kWh/machine shift	2.161	27.63 kWh
Steel bar straightening machine	14 mm	15.10 kWh/machine shift	1.621	24.47 kWh
Truck-mounted crane	Lifting capacity: 8 t	28.40 kg diesel/machine shift	0.492	11.07 kg diesel
Motorized dump truck	Loading capacity: 1 t	6.00 kg diesel/machine shift	10.578	63.468 kg diesel
Steel bar cutting machine	Diameter: 40 mm	32.10 kWh/machine shift	0.772	24.78 kWh
Truck	Loading capacity: 6 t	33.20 kg diesel/machine shift	154.734	5,138.202 kg diesel
Woodworking circular saw machine	Diameter: 500 mm	24.00 kWh/machine shift	49.09	1202.46 kWh