



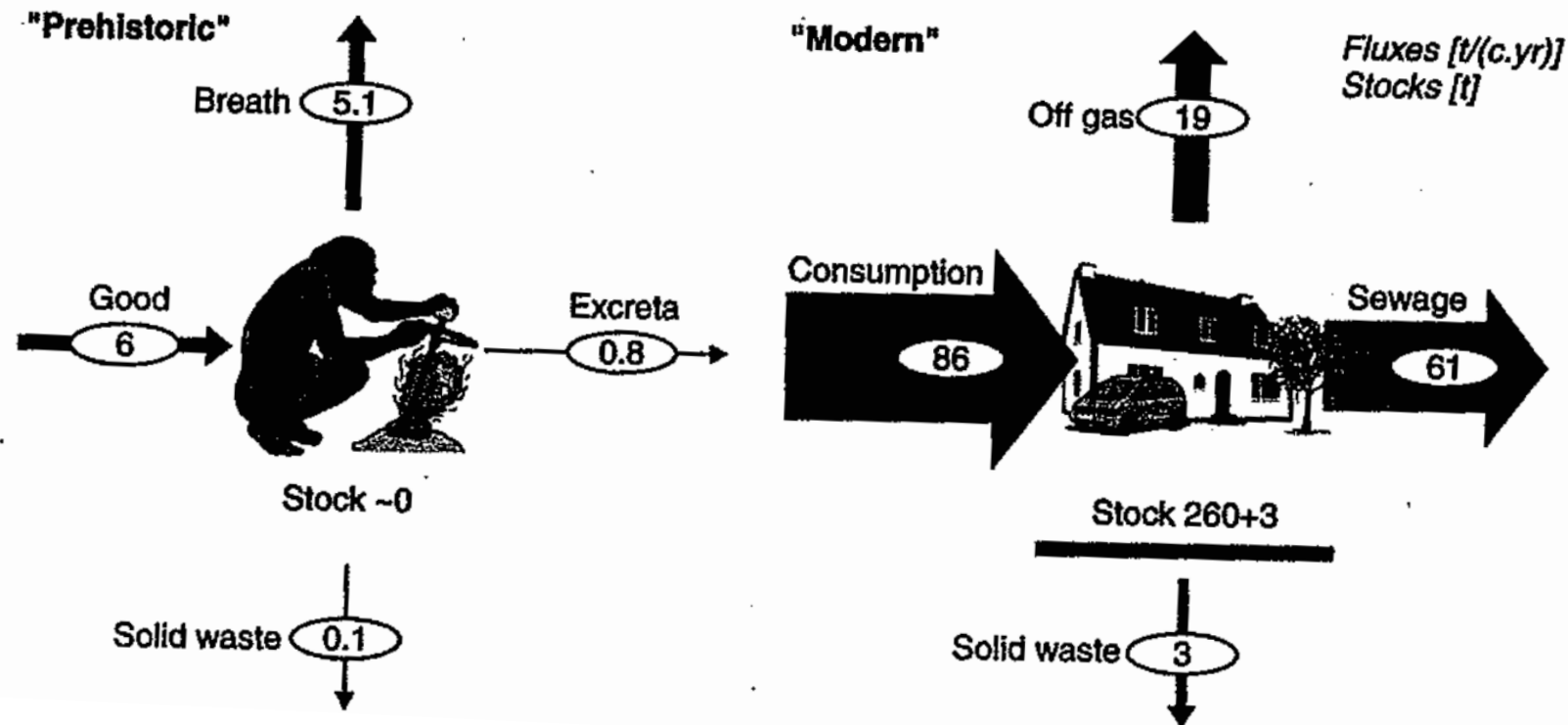
Material composition of buildings

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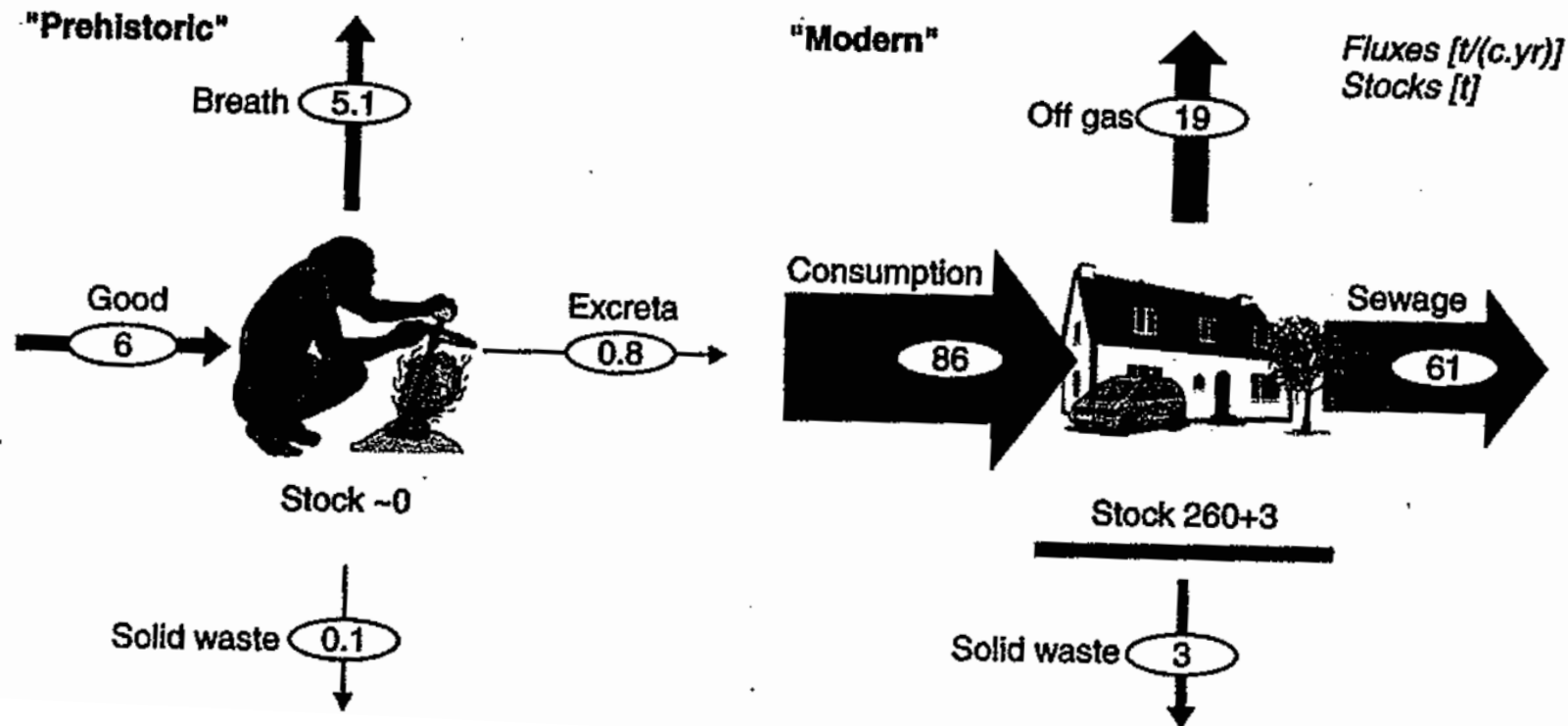
Paul Gontia

Background

A short history of material stock



A short history of material stock

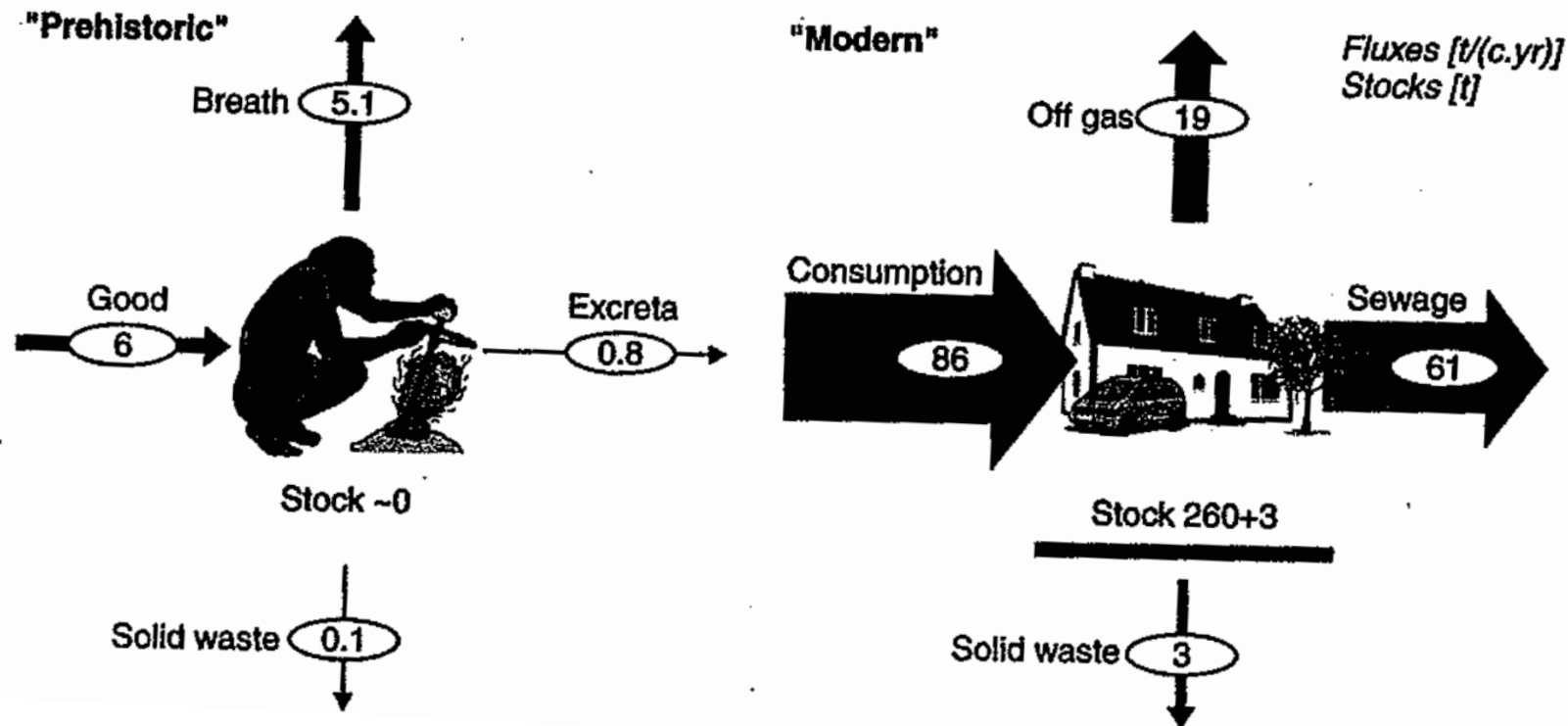


Population

200.000

8.000.000.000

A short history of material stock



Material types

organic

man-made



Globally: increased 23-fold
Accelerating: developing countries
Increasing: developed countries

Christian rituals and the end-of-life of materials



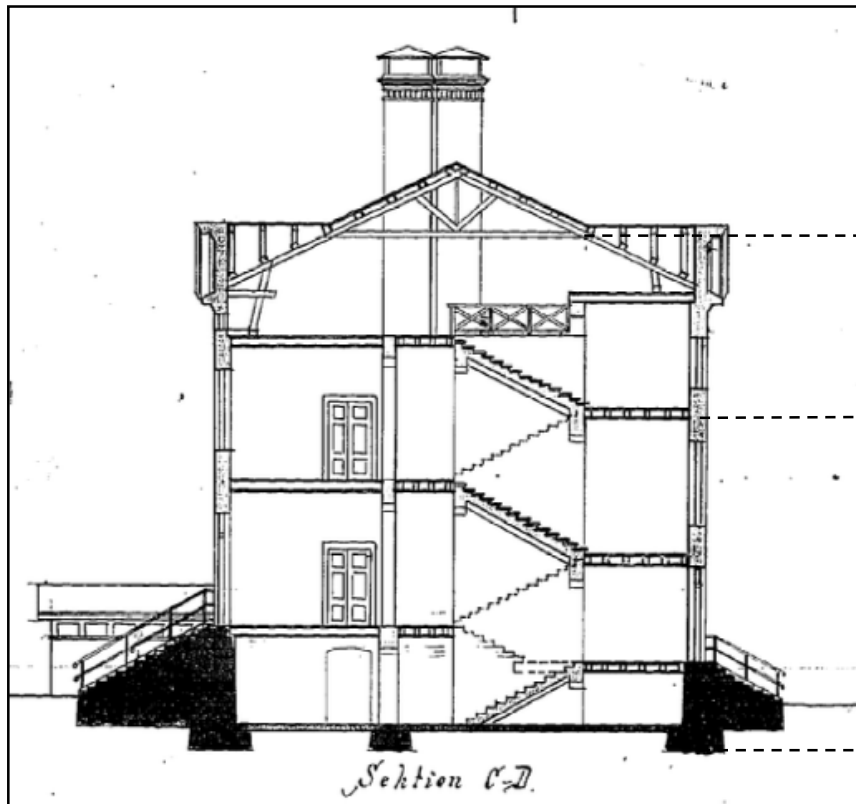
Material stock - growth Implications

- Large quantities of demolition waste
- Pressure on natural capital
- Local and global environmental impacts
- Built environment can be seen as repository of resources

Methodology

Material composition database

Architectural plans



Density of construction materials

Wood: 455 kg/m^3

Brick: 1600 kg/m^3

Stone: 2000 kg/m^3

Material composition

=

Wood

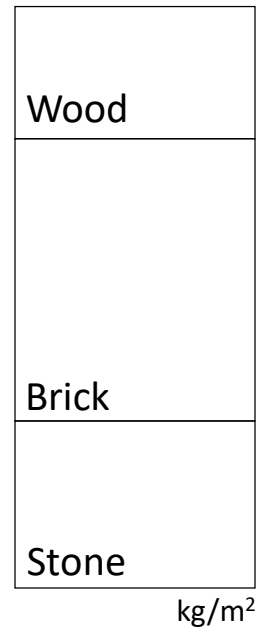
Brick

Stone

kg/m^2

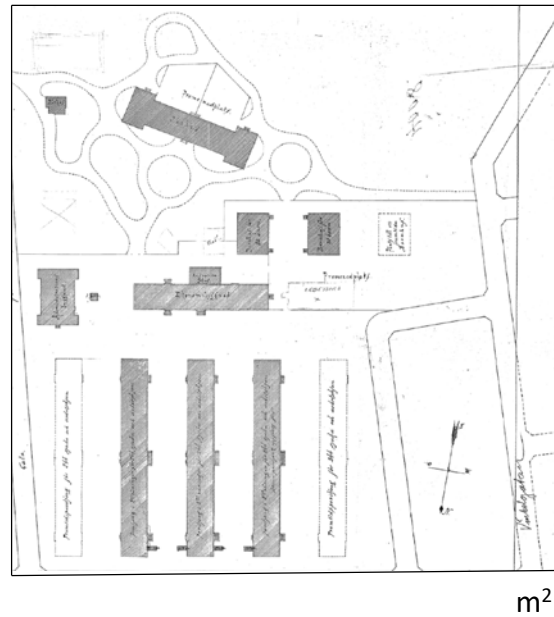
Bottom-up material stock

Material composition



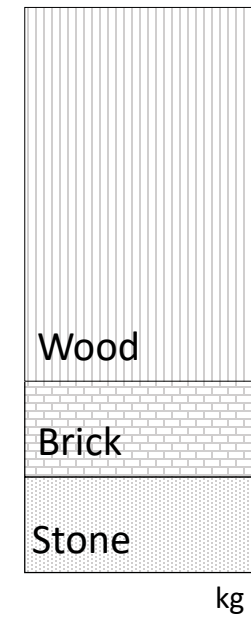
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Geospatial data



=

Material stock



Results: material composition database

Multi-family (MF)

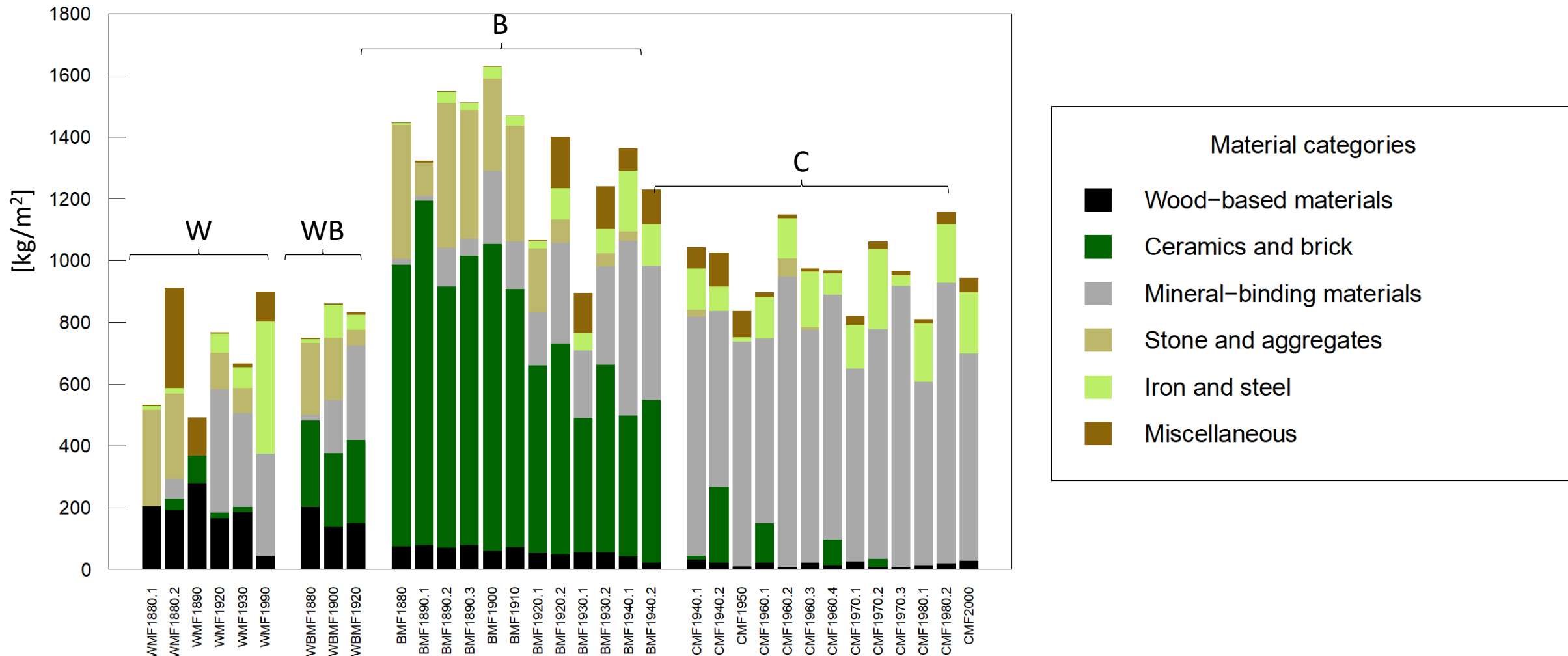


Single-family (SF)

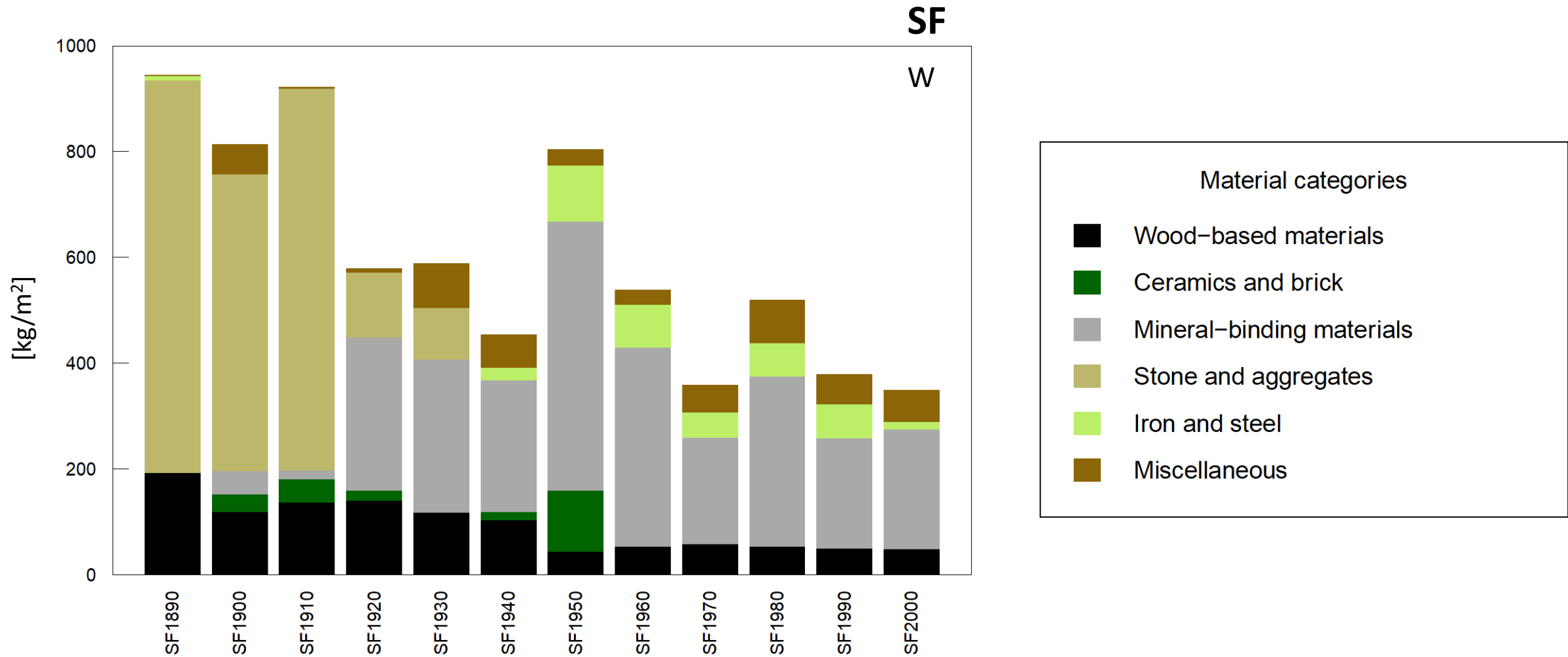


Material composition database

MF



Material composition database



Construction material	Density [kg/m ³]	Material category	Source
Asphalt-fiber board	336	Wood-based materials	Malik, 2012
Cardboard	546		MASEA, 2016
Cork	150		MASEA, 2016
Kerto beam	462		MASEA, 2016
Laminated floor	350		MASEA, 2016
MDF	500		Hegger, 2006
Oil-tempered hardboard	700		MASEA, 2016
Paper	648		MASEA, 2016
Particleboard	620		MASEA, 2016
Plywood	427		MASEA, 2016
Porous fiberboard	400		Hegger, 2006
Round wood	455		MASEA, 2016
Sawdust	150		MASEA, 2016
Windproof paper	648		MASEA, 2016
Wood wool	460		MASEA, 2016
Wooden batten	455		MASEA, 2016
Wooden beam	455		MASEA, 2016
Wooden floor-boards	455		MASEA, 2016
Wooden panels	455		MASEA, 2016
Wooden plank	455		MASEA, 2016
Wooden truss	455		MASEA, 2016
Wooden window-frame	455		MASEA, 2016
Clay brick	1644	Ceramics and brick	MASEA, 2016
Clay roof-tile	1644		MASEA, 2016
Clay, dry excavated	1089		MASEA, 2016
Leca block	525		MASEA, 2016
Plaster clay	1514	Mineral-binding materials	MASEA, 2016
Aerated concrete	415		MASEA, 2016
Asbestos cement	1675		Cembrit, 2009
Concrete	2104		MASEA, 2016
Concrete-brick with holes	1000		MASEA, 2016
Concrete roof-tile	2104		MASEA, 2016
Concrete sawdust mix	1000		MASEA, 2016
Crushed lightweight concrete	78		MASEA, 2016
Lightweight concrete	494		MASEA, 2016
Lime-sand brick	1900		MASEA, 2016
Plaster board, exterior	732		MASEA, 2016
Plaster board, interior	732		MASEA, 2016
Plaster concrete	2000		MASEA, 2016
Plaster lime	1600		MASEA, 2016
Plaster terrasit	2000		MASEA, 2016
Plaster gypsum	1000		MASEA, 2016
Screed	2058		MASEA, 2016
Gravel	1850	Stone and aggregates	MASEA, 2016
Sand	1300		MASEA, 2016
Slate stone	2690		Simetric, 2016
Stone	2400		MASEA, 2016
Roof cover metal sheet	8000	Iron and steel	MASEA, 2016
Steel bars	8000		MASEA, 2016
Steel profiles	8000		MASEA, 2016
Steel profile sheets	8000		MASEA, 2016
Coke ash	900	Miscellaneous	MASEA, 2016
Copper sheet	9000		MASEA, 2016
EPS insulation	53		MASEA, 2016
Foil	940		MASEA, 2016
Glass	2580		MASEA, 2016
Granulated blast furnace	1000		MASEA, 2016
Mineral wool	160		MASEA, 2016
Mineral wool, hard	350		MASEA, 2016
Mineral wool, loose	60		MASEA, 2016
Peat	400		Simetric, 2016
Reed	150		MASEA, 2016
Seagrass mat	150		MASEA, 2016
Slag	790		MASEA, 2016
Slag brick	790		MASEA, 2016
Tar paper	1200		MASEA, 2016
XPS insulation	34		MASEA, 2016

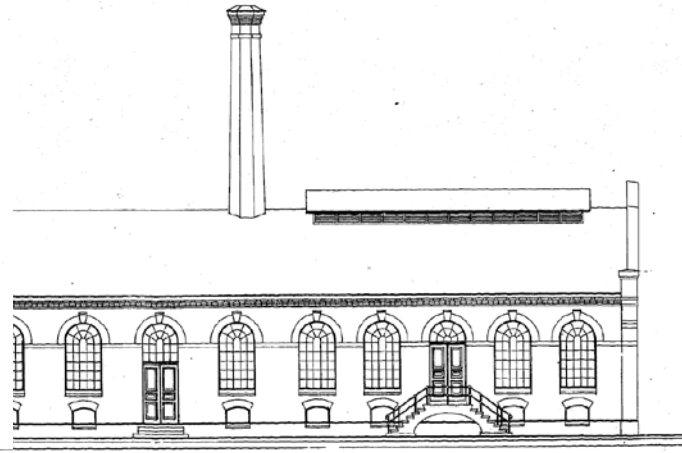
Construction materials

Extended material composition

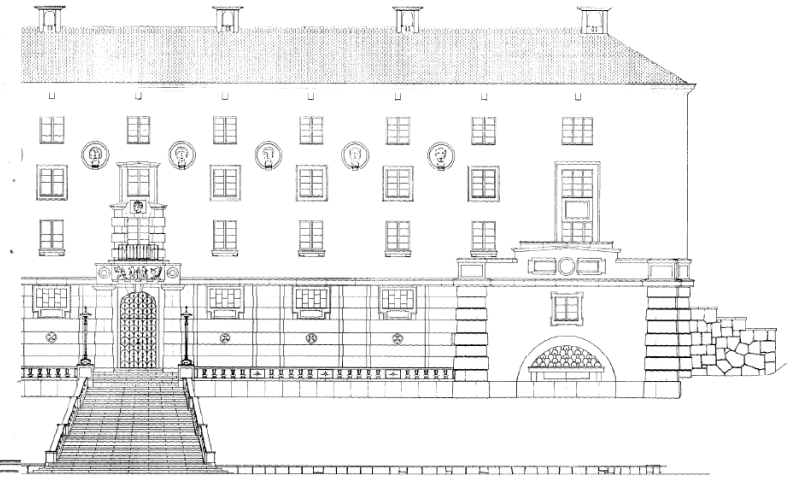
	1890's	1900's	1910's	1920's	1930's	1940's	1950's	1960's	1970's	1980's	1990's	2000's
Basement												
With	100%	100%	100%	90%	90%	80%	60%	40%	30%	-	-	-
Without	-	-	-	10%	10%	20%	40%	60%	70%	100%	100%	100%
Facade material												
Wood	100%	30%	60%	70%	40%	50%	20%	20%	15%	60%	60%	60%
Plaster	-	70%	30%	30%	60%	50%	20%	-	-	15%	40%	40%
Brick	-	-	-	-	-	-	50%	70%	45%	25%	-	-
Mix	-	-	10%	-	-	-	10%	10%	40%	-	-	-
Number of floors												
1 floor	-	-	-	-	10%	30%	45%	55%	20%	20%	20%	-
1.5 floors	100%	100%	100%	90%	50%	10%	20%	20%	65%	65%	45%	50%
2 floors	-	-	-	10%	40%	60%	35%	25%	15%	15%	35%	50%



Economic

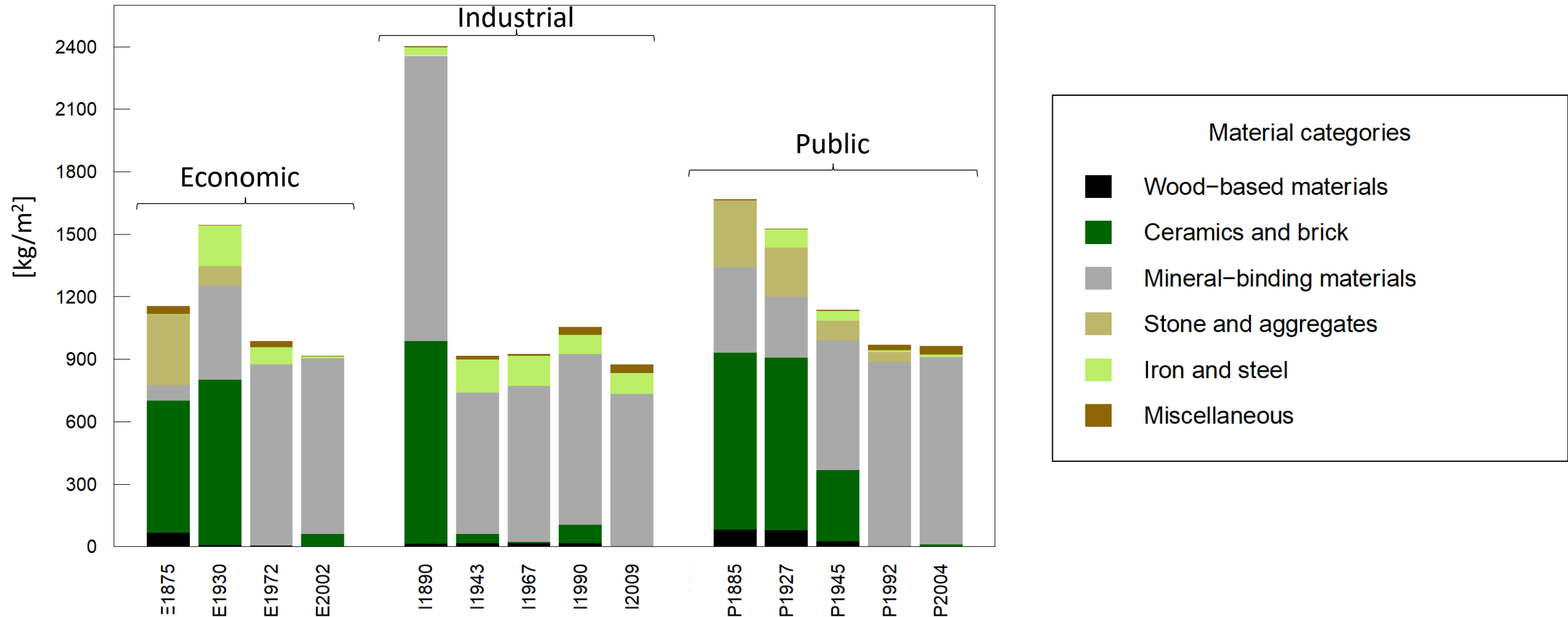


Industrial



Public

Material composition database





**Material composition of buildings
Material stock in Swedish cities**

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