SUMMER COURSE 2021
GREEN INFRASTRUCTURE ADAPTING TO CLIMATE CHANGE

21 July 2021

PRECAST CONCRETE CONSTRUCTION : A GREEN CONSTRUCION

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DAFTAR ISI

01-INTRODUCTION

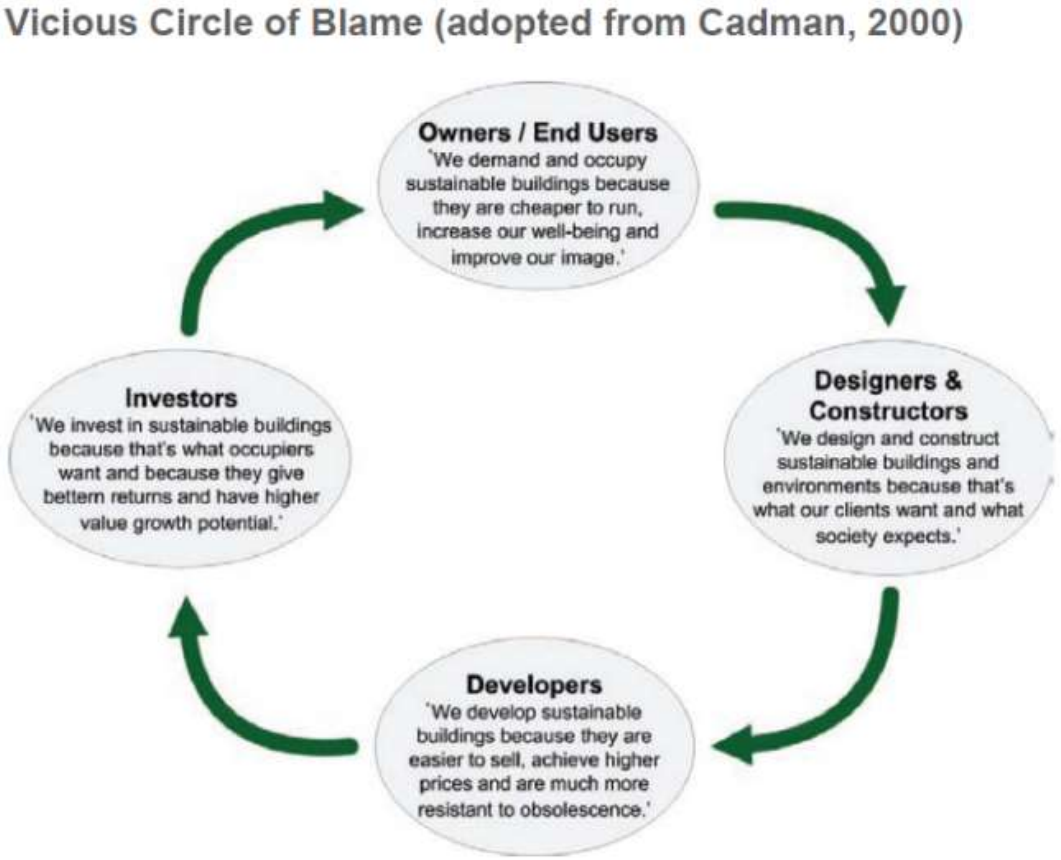
INTRODUCTION

- Sustainable construction is an aspect developed worldwide as a response to climate change
- Use of energy in integrally optimal fashion starting from natural resources, design, construction, operation, and demolition
- Concrete precast system is a method of construction conforming to green construction, since the system applies efficient working method and material such that energy is used optimal

INTRODUCTION

- Integrated design between architects, structure engineer and utility engineer respect to Life Cost Analysis (LCA)
- The building is huge potential for CO2 emission reduction targets, and also the least expensive way to working on it.
- Generally, the concept of sustainable development requires a large initial investment cost, which is often considered to be an additional financial burden for the owner / investor building

INTRODUCTION



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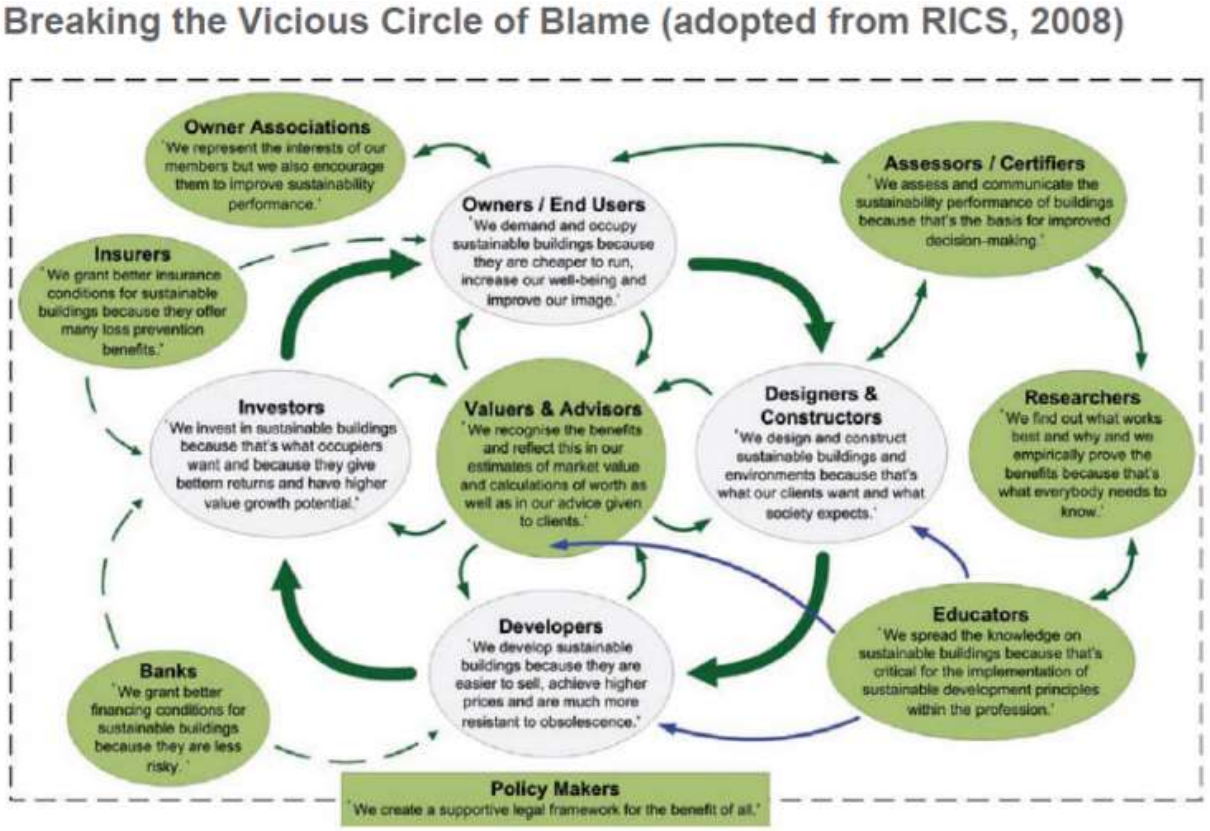
INTRODUCTION



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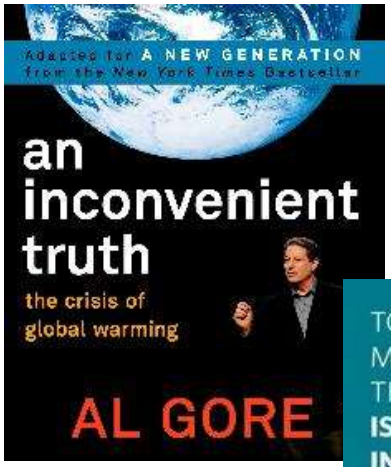
INTRODUCTION

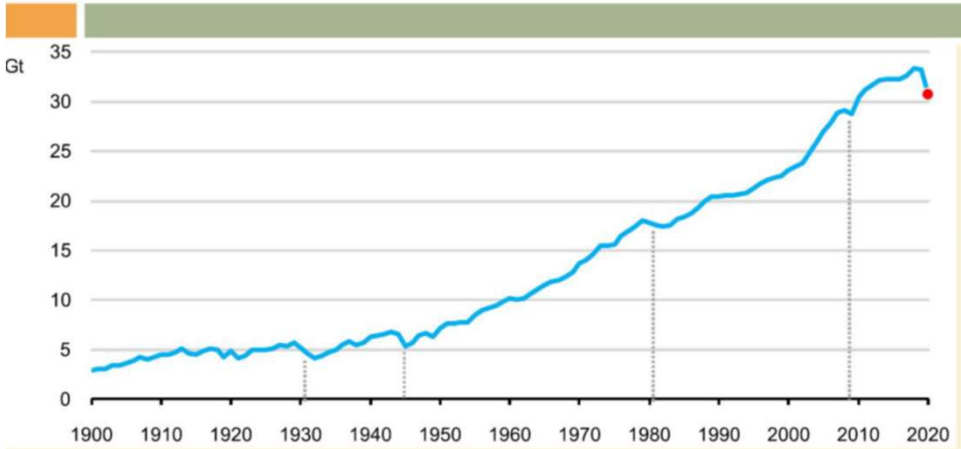


I'm President of Pittsburg, not Paris
Man cannot control the climate !

Are climate change because of human behavior ?

Introduction

COVID 19 dan sektor energi



- Penurunan konsumsi energi menyebabkan terjadi penurunan emisi global 5% di Q1 2020 dibandingkan Q1 2019 (8% batubara, 4.5% minyak dan 2.3% gas)
- Penurunan emisi GRK bulan April 2020 mencapai 17% dibandingkan 2019

02 – PRECAST CONSTRUCTION EXAMPLE IN INDONESIA

PRECAST EXAMPLE

Video: High Performance Precast Seismic System The Hive (2014)

Video : Low Cost Housing 18 hour erection PT Wijaya Karya Beton

Video : Mass production of Precast low cost housing National Housing Development

PENDAHULUAN

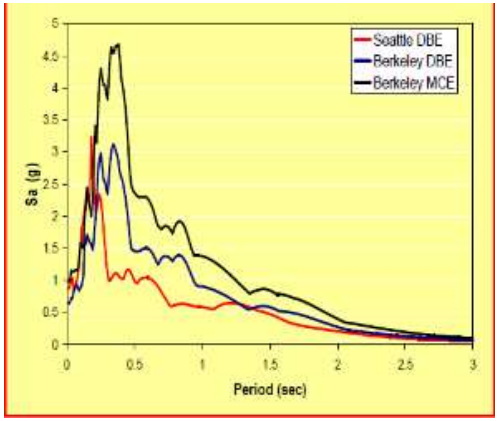
Video : Precast Lego Movie : High End Housing

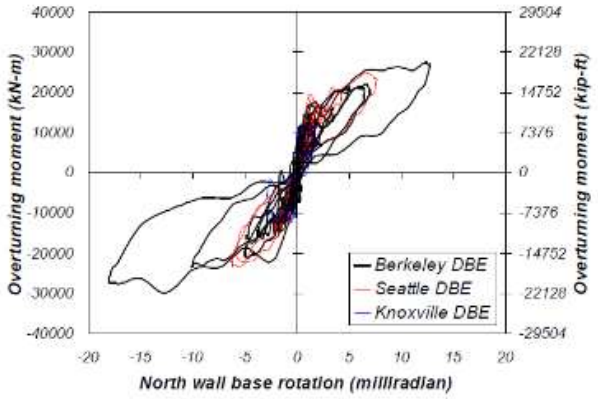
PENDAHULUAN

Video : Prefabricated Prefinished Volumetric Construction di Rumah Sakit Covid Galang (2020)

- Video : Project Tokyo Riverside Apartment 32 Storey With Precast Emulated Cast In Place (2020)

PRECAST EARTHQUAKE TESTING





Berkeley maximum consider earthquake risk (MCE_R , T=2500 tahun)

PRECAST EARTHQUAKE TESTING

PRECAST EARTHQUAKE TESTING

03 – RESEARCH OF GREEN CONSTRUCION

QUALITATIVE RESEARCH

- Performed on research works by Green Building Council of Indonesia (GBCI) (2012-2014)
- inspect how precast construction was elaborated in the determination of green construction category.
- Generally, there exist seven aspects in building assessment, should that building be designed with sustainable concept,

QUALITATIVE RESEARCH

Category	Precast concrete contribute to greenship points
Appropriate Site Development	ASD 6 – Micro climate (Heat island effect – Albedo)
Energy Efficiency and Conservation	EEC P2 – OTTV calculation
Water Conservation	
Material Resources and Cycle	MRC 1 – Building and material reuse MRC 2 – Environmentally processed product MRC 5 – Modular design/prefab material MRC 6 – Regional material
Indoor Health and Comfort	IHC 3 – Chemical pollutant
Building Environment Management	BEM 2 – Pollution of Construcion Activity
Innovation	

QUALITATIVE RESEARCH

- The main green aspect of precast is in Material Resources and Cycle : the concept is known by “3R” : Reduce, Reuse,Recycle
  - Reduce
    - Concrete is local material in Indonesia
    - Design able to save the use of steel bar (as a reward to good quality control)
    - Method save scaffold and zero waste
  - Reuse : precast mold used 10 – 15 times compare to 2 – 3 times in conventional system
  - Recycle
    - molding material : iron or fibre
    - Grouting material has a green lable

QUALITATIVE RESEARCH

- Comparing to conventional concrete method :
  - needs a lot of wood formwork and support, and wasted it after construction
  - And also have a lot of wastes : concrete in pouring process and steel in cutting process






QUALITATIVE RESEARCH

Half Slab

Full Slab

Precast needs less material for support

QUALITATIVE RESEARCH






Planning of bar bending schedule in the workshop :

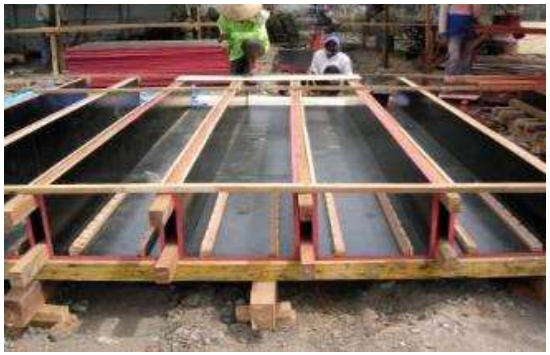
Close to zero waste in steel bars cutting

QUALITATIVE RESEARCH

Casting in mold at ground floor :

Close to zero waste in concrete pouring

QUALITATIVE RESEARCH


High rate of reusing of formwork

QUANTITATIVE RESEARCH

- Performed on the use of energy and its environmental impact on several construction systems of low cost apartments in Batam (2011-2012)
- High Performace Earthquake Resistant precast systems with low initial investation in Indonesia (2013-2014)

SEMINAR SEKOLAH PASCASARJANA

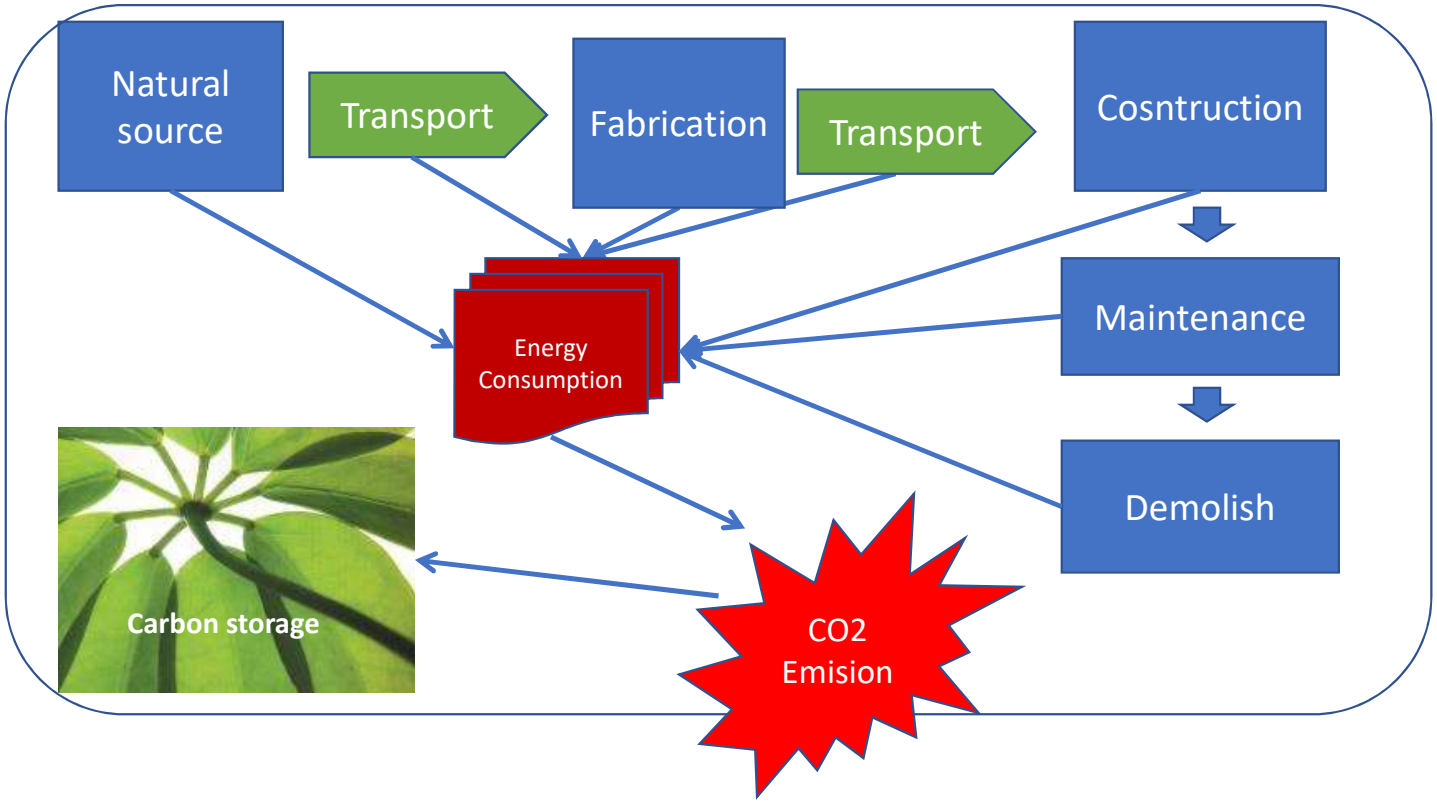
INSTITUT PERTANIAN BOGOR

Nama	:	Hairul Sitepu
NRP	:	P062059324
Program Studi	:	Pengelolaan Sumberdaya Alam dan Lingkungan
Bidang Minat	:	Kebijakan dan Manajemen Lingkungan
Judul Penelitian	:	**Pengembangan Rumah Susun Sederhana Sewa (Rusunawa) Yang Ramah Lingkungan Melalui Optimasi Pelaksanaan Konstruksi Hijau (*Green Construction*)**
Komisi Pembimbing	:	1. Dr. Ir. Aris Munandar (Ketua)
		2. Prof. Dr. Ir. Bambang Pramudya (Anggota)
		3. Dr. Ir. Etty Riani (Anggota)
		4. Dr. Ir. Rinekso Soekmadi (Anggota)
Kelompok	:	Ilmu-Ilmu Sosial
Hari, Tanggal	:	09 April 2011
Pukul	:	12.00 WIB
Tempat	:	Ruang Cempaka, Kampus IPB Baranangsiang

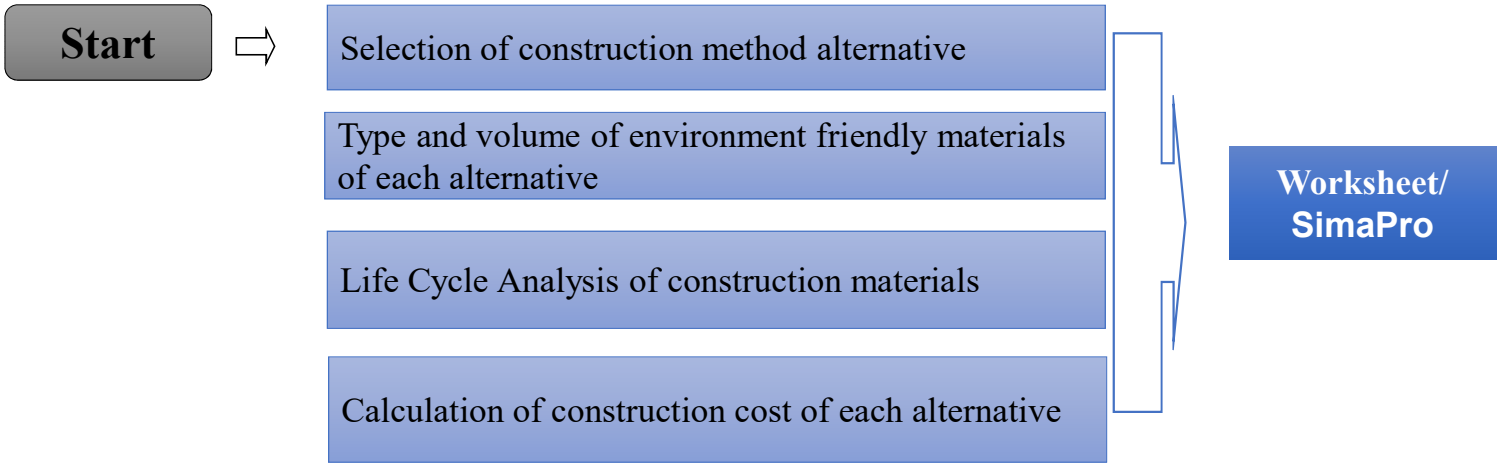
QUANTITATIVE RESEARCH : construction energy and environmental impact

- Energy calculation and environmental impact of each item of construction works based on Goedkoop and Oele
- Equalization process for comparison by the method of LCA (life cycle analysis) through Simapro 5.0
- Starting from the retrieval of natural, manufactured, used, maintenance, to demolition and return to nature

CONSTRUCTION MATERIAL OPTIMAZION



QUANTITATIVE RESEARCH : **construction energy and environmental impact**



Life Cycle Assesment (LCA)

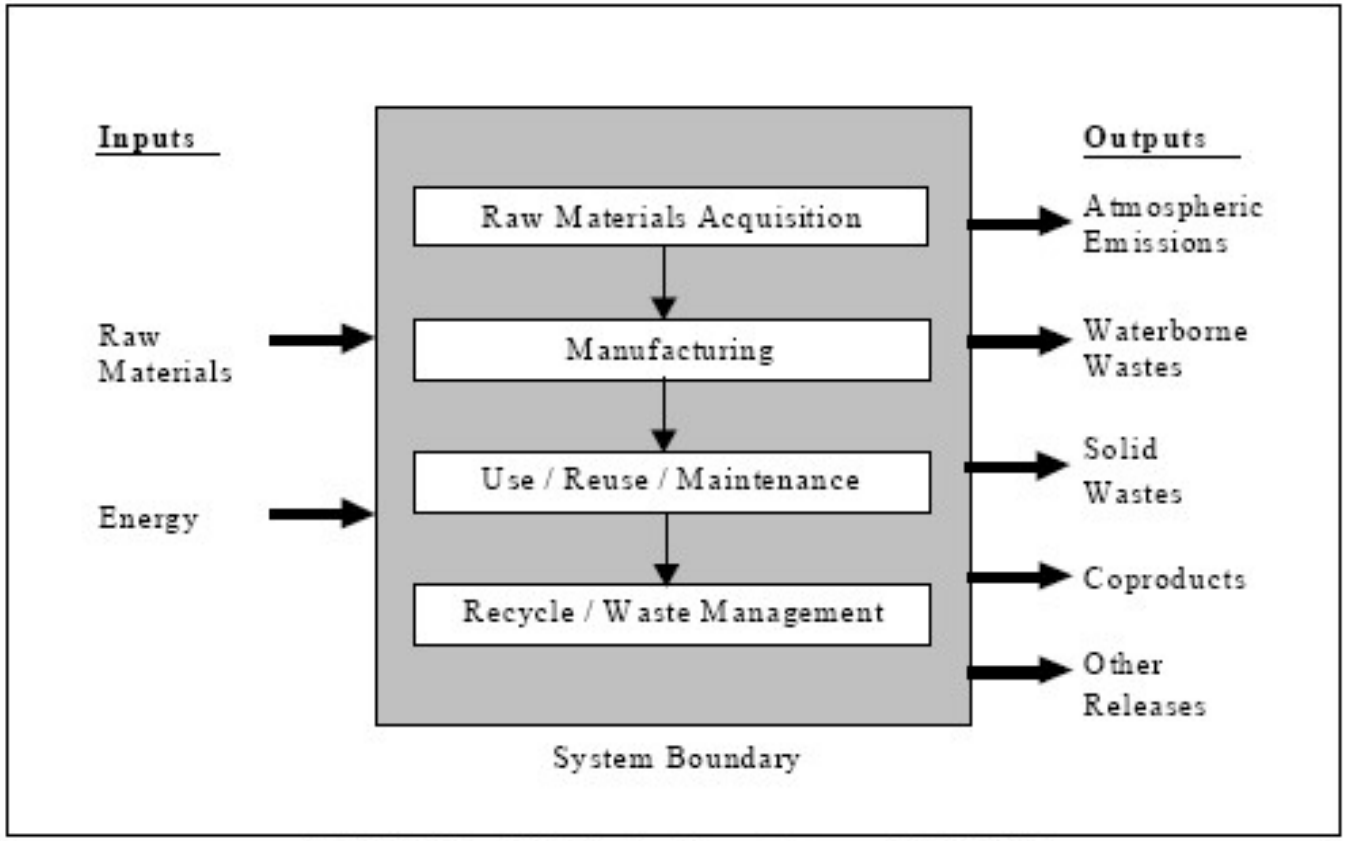
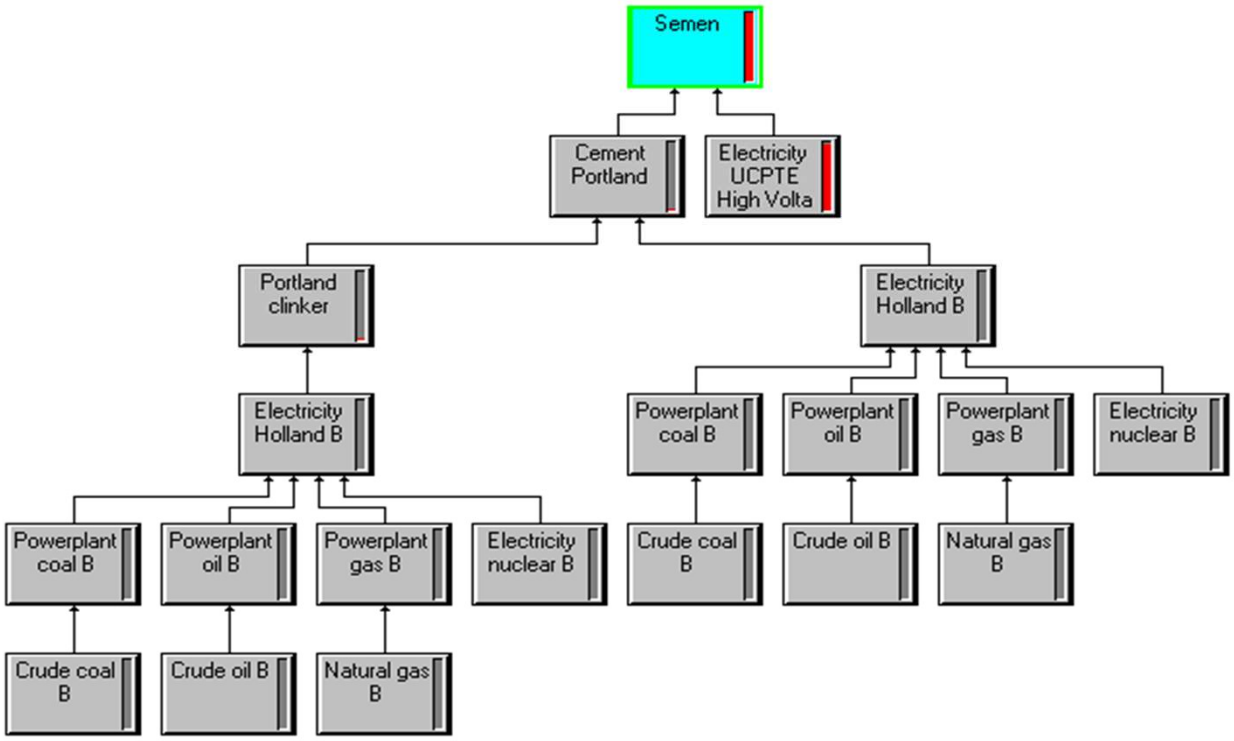


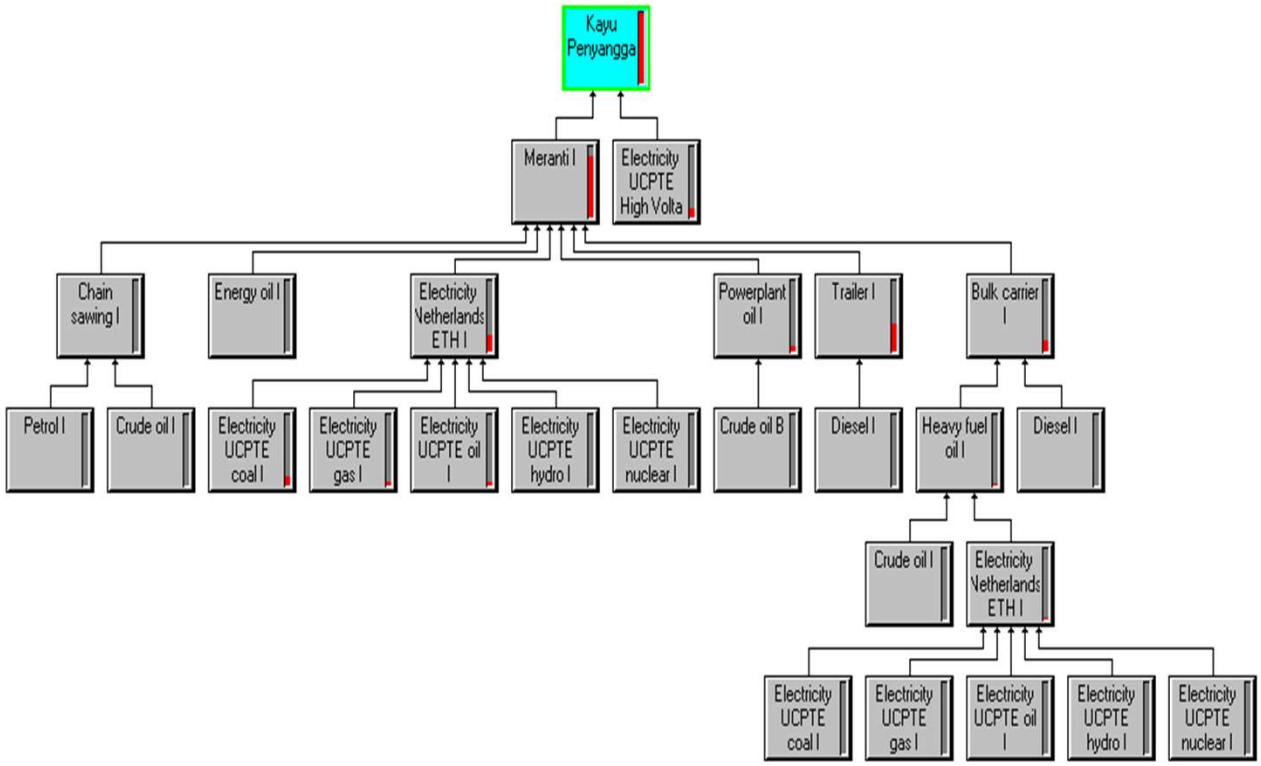
Exhibit 1-1. Life Cycle Stages (Source: EPA,1993)

Software SimaPro 5,

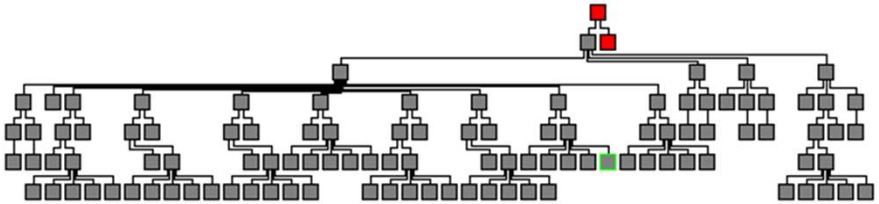
Tree diagram : Cement

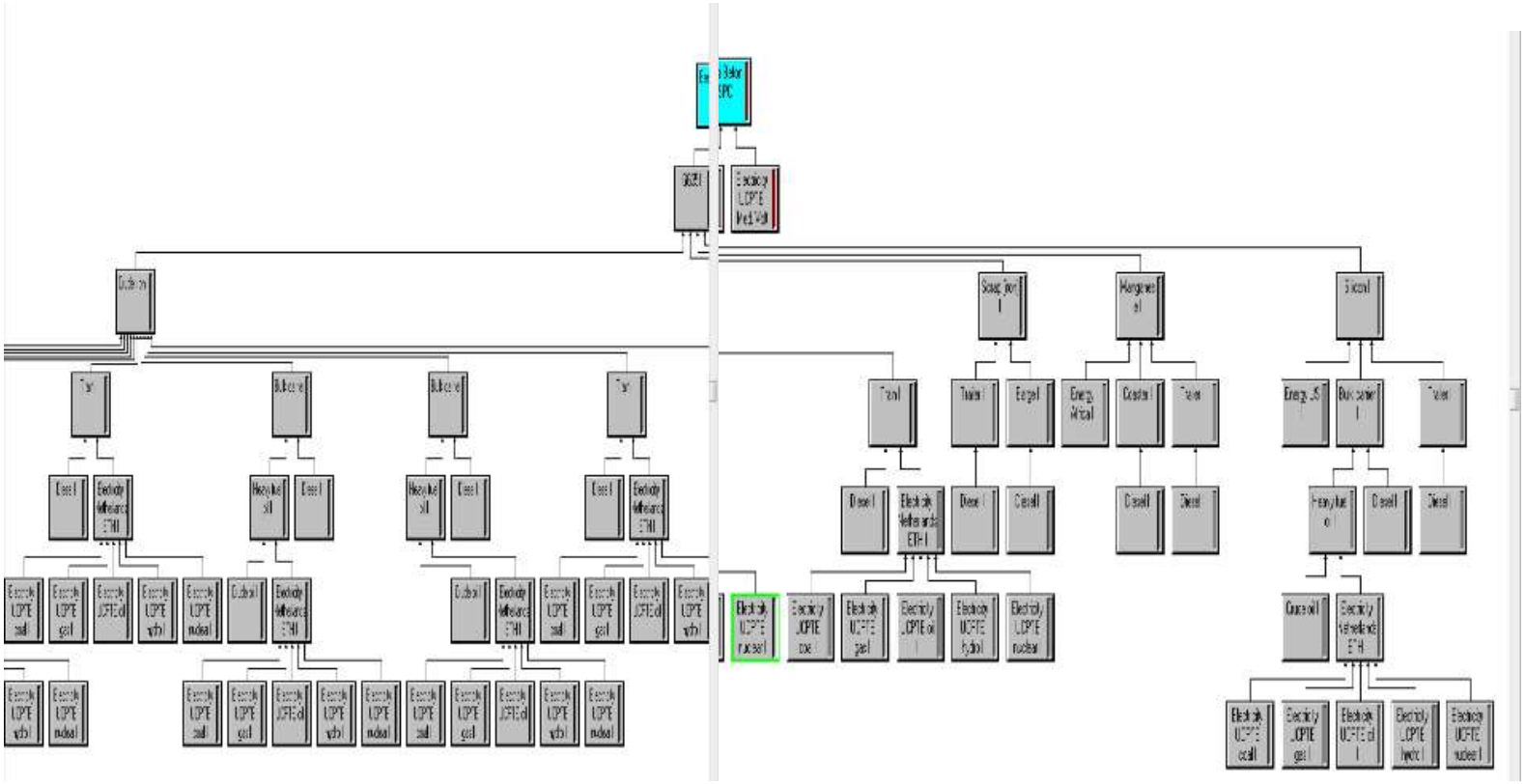


Tree Diagram : Wood support

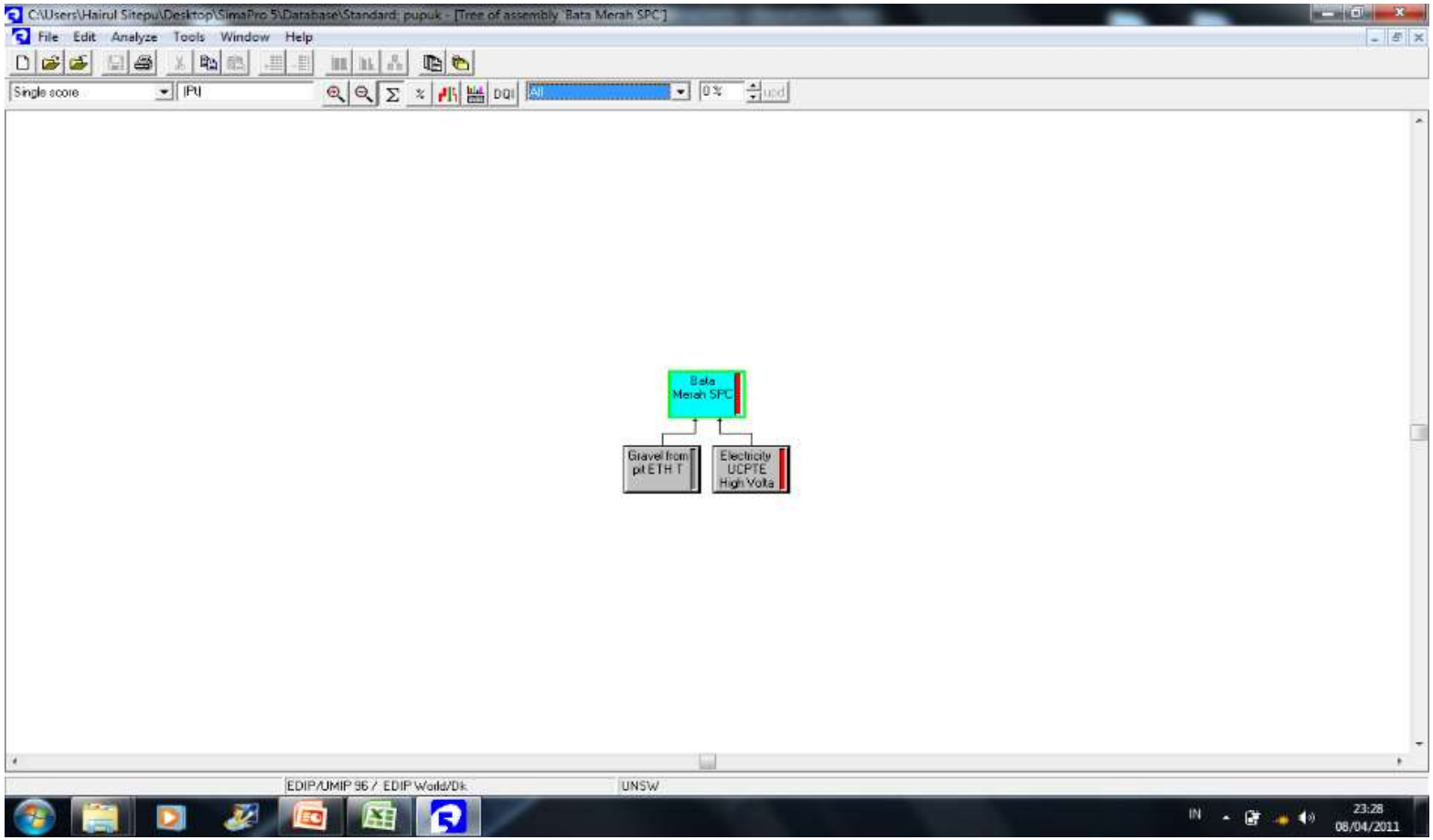


Tree Diagran : Steel Bars

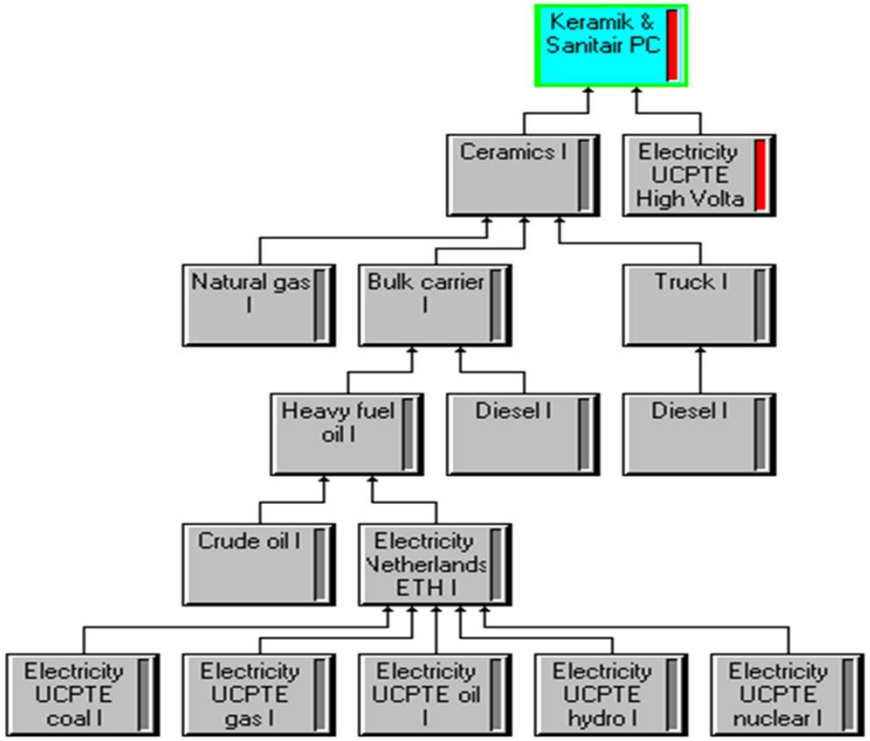




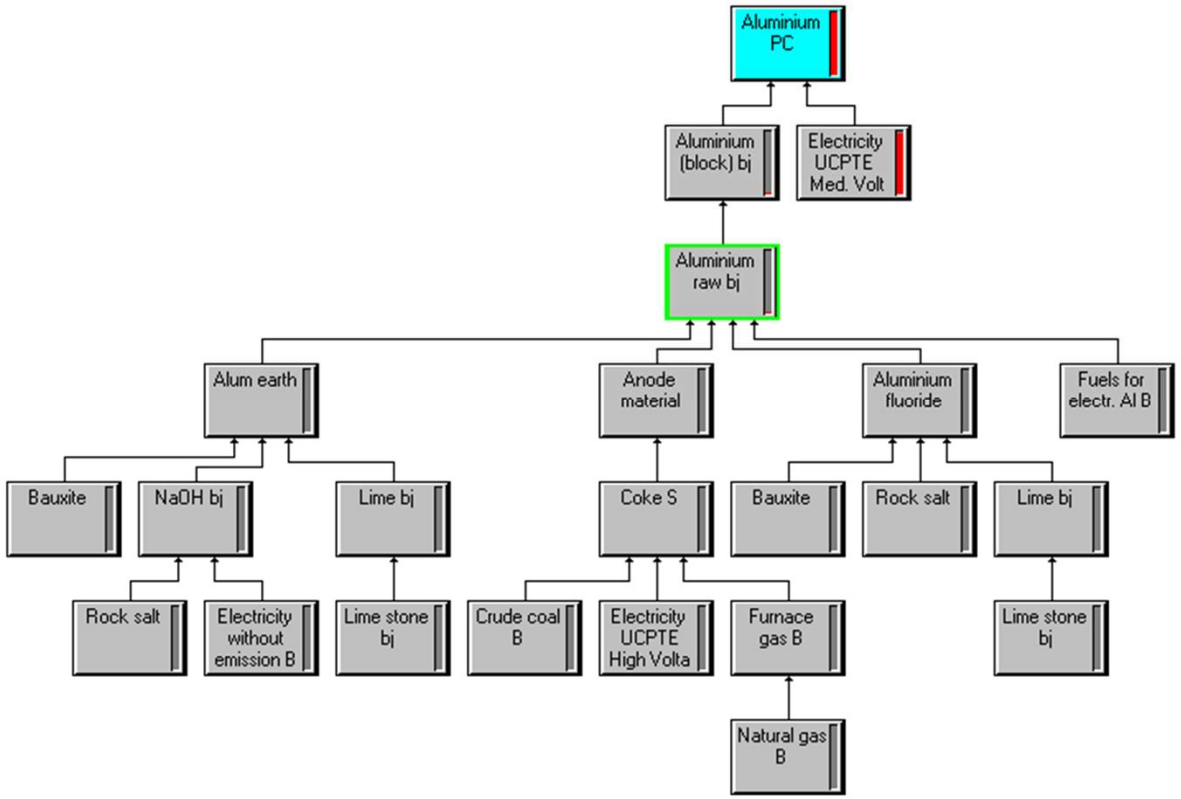
Tree Diagram : Bata Merah (Red Brick)



Tree Diagram : Tile & Saniter



Tree Diagram : Aluminium



RESEARCH LOCATION

QUANTITATIVE RESEARCH： construction energy and environmental impact

QUANTITATIVE RESEARCH：construction energy and environmental impact

- Conventional :
  - Structural
  - Architectural
- Half Precast :
  - Precast Strucural System
  - Conventional architectural system
- Full precast system both structural and architectural

QUANTITATIVE RESEARCH : construction energy and environmental impact

Half Precast System

QUANTITATIVE RESEARCH :

construction energy and environmental impact

Full Precast System

QUANTITATIVE RESEARCH :

and environmental impact

construction energy

Full Precast System

QUANTITATIVE RESEARCH :

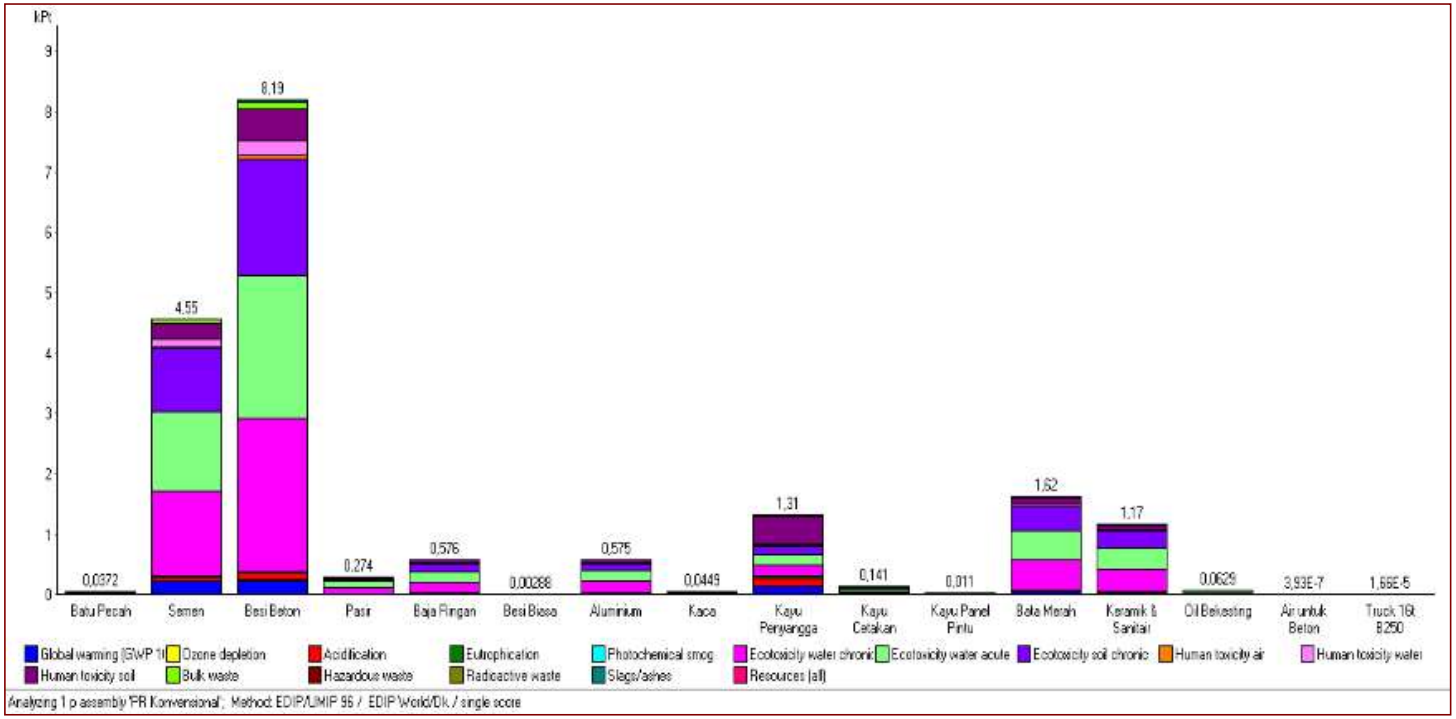
construction energy and environmental impact

No	Main component	Conventional	Partially Precast	Full Precast
1	Cement	488 ton	499 ton	617 ton
2	Fine aggregate	3.483 m3	3.354 m3	687 m3
3	Coarse aggregatre	339 m3	398 m3	642 m3
4	**Reinforcement bar**	**180 ton**	**77 ton**	**122 ton**
5	**Mold**	**wood 41 m3**	steel 7,9 ton	steel 9,2 ton
6	**Perancah**	**wood 562 m3**	steel 7,8 ton	steel 7,8 ton
7	Bata merah	413.216 nos	413.216 nos	-
8	Skill labour	20 org	30 org	40 org
9	Unskill labour	80 org	45 org	15 0rg
10	Cost (Rp x 1.000 million)	13,657	11,500	11,434
11	No. of stories /area	4 lt/4.600 m2	4 lt/4.600 m2	4 lt/4.600 m2
12	Construction time (month)	8	6	5

*) Precast technology used is from one of the national precaster

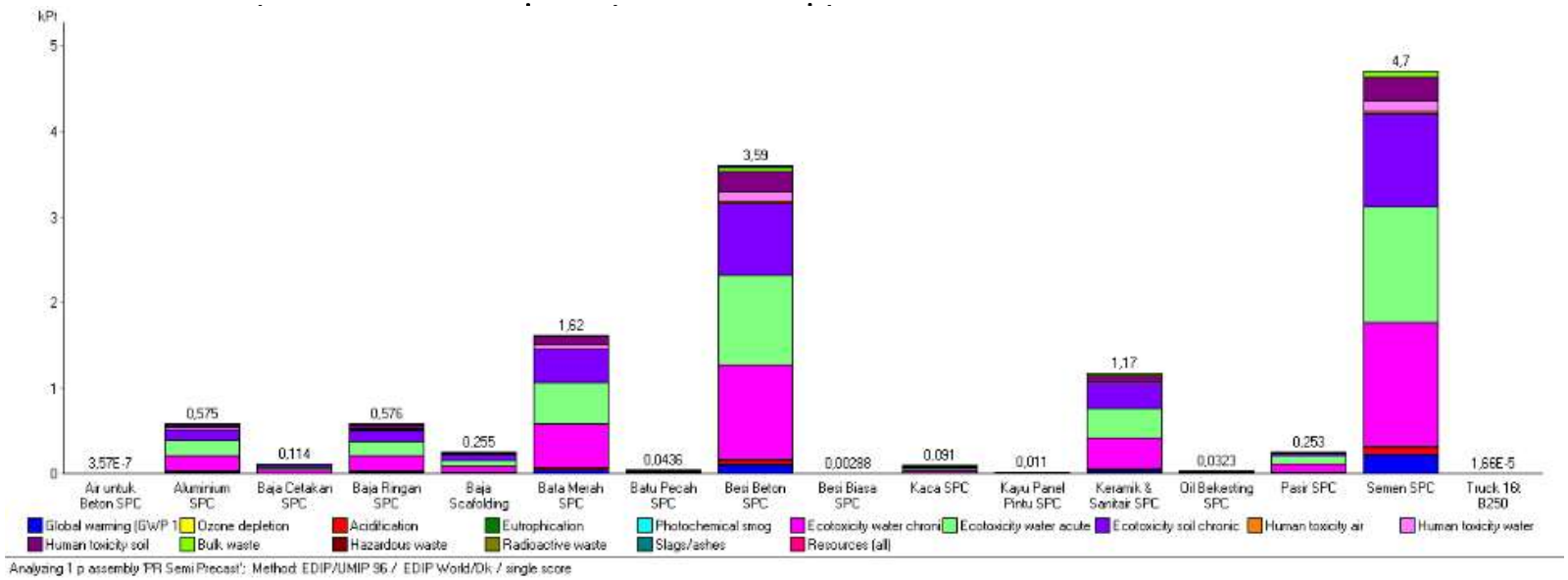
QUANTITATIVE RESEARCH :

construction energy and environmental impact



LCA Single Score : Conventional Concrete System

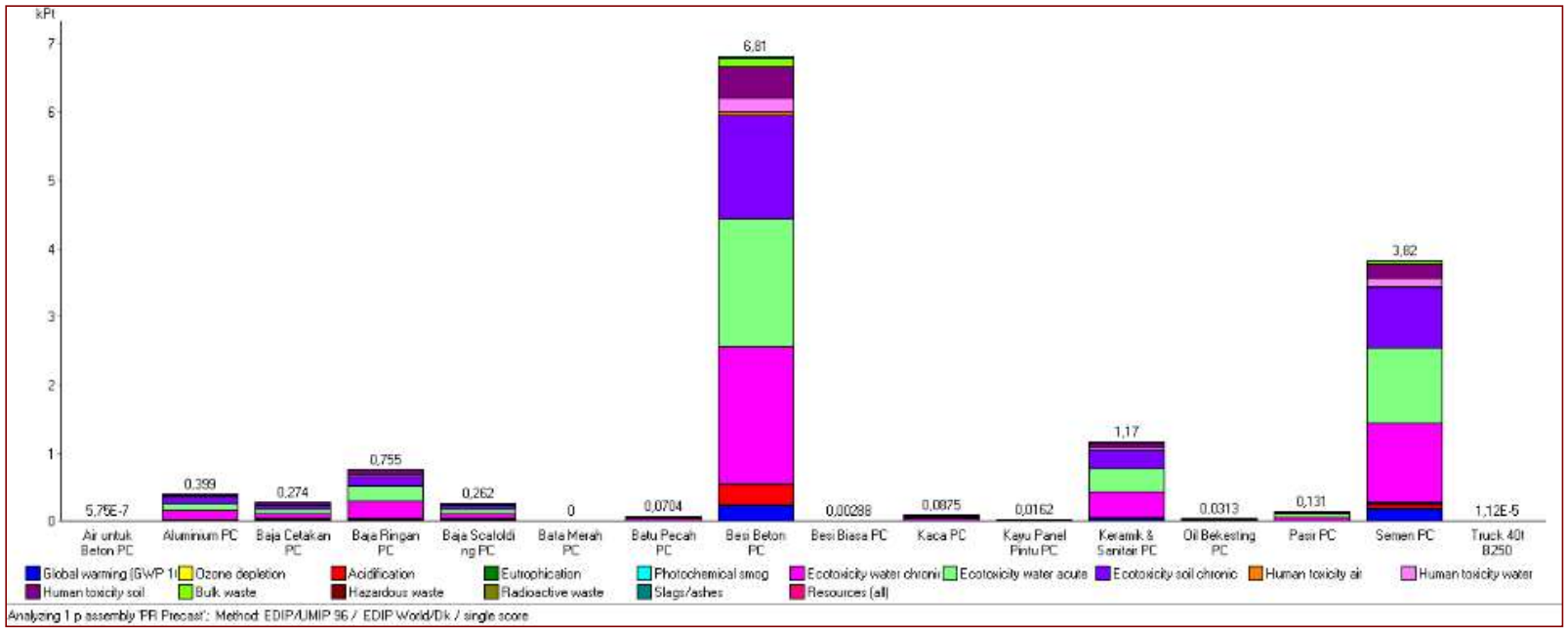
QUANTITATIVE RESEARCH :



LCA Single Score : Half Precast System

QUANTITATIVE RESEARCH :

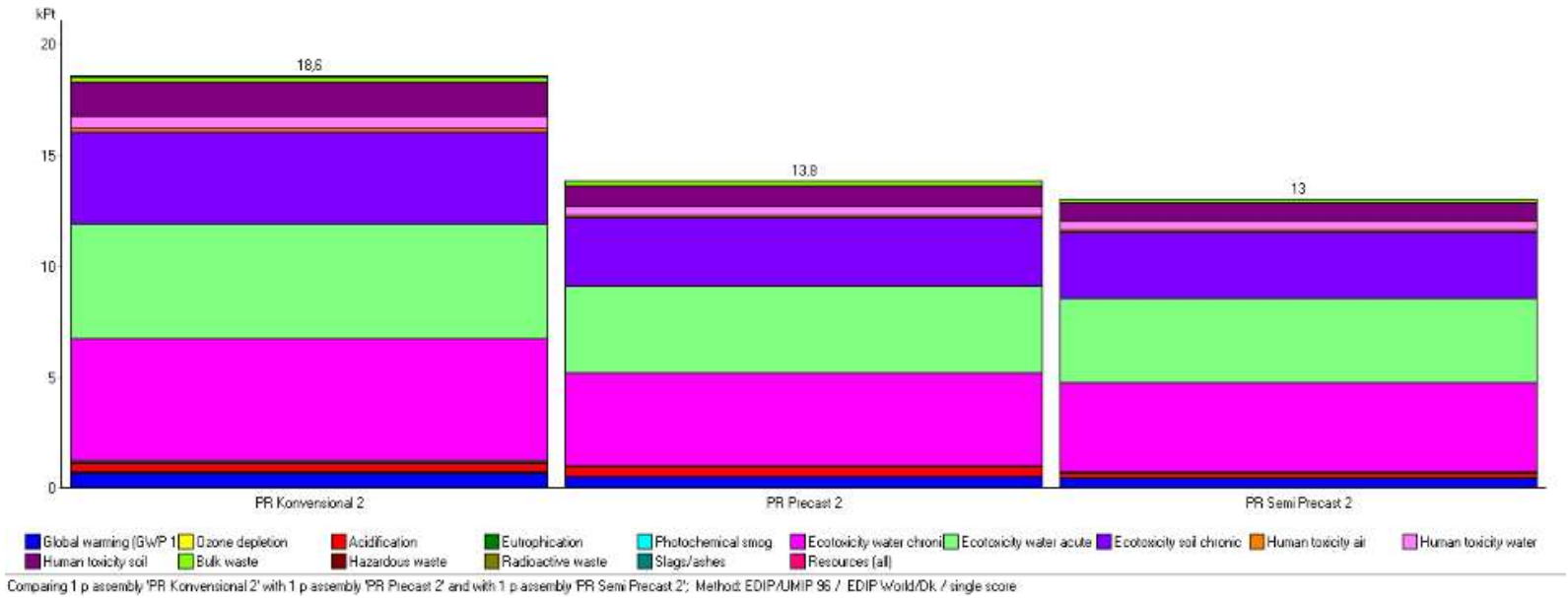
construction energy and environmental impact



LCA Single Score : Full Precast Concrete System

QUANTITATIVE RESEARCH :

construction energy and environmental impact



Comparison of single score of each alternative. Partially Precast System is 31% lower than conventional system and 6% lower than full precast system

QUANTITATIVE RESEARCH :

construction energy and environmental impact

Construction alternative dan Pollutant potential of main building material	Katagori Dampak Lingkungan (Pt)			Energy (kWh)
	Chronic toxic waters	Acute toxic waters	Chronic toxic soils	
Conventional:				1.253.774,7
-steel bar	$5{,}18 \times 10^{8}$	$4{,}95 \times 10^{7}$	$2{,}53 \times 10^{7}$	
-cement	$2{,}85 \times 10^{8}$		$1{,}39 \times 10^{7}$	
-aluminum		$3{,}68 \times 10^{6}$		
Partially precast:				806.981,9
-cement	$2{,}94 \times 10^{8}$	$2{,}82 \times 10^{7}$	$1{,}43 \times 10^{7}$	
-steel bar	$2{,}27 \times 10^{8}$	-	$1{,}11 \times 10^{7}$	
-red brick		$9{,}97 \times 10^{6}$		
Full precast:				1.008.199,9
-steel bar	$4{,}11 \times 10^{8}$	$3{,}92 \times 10^{7}$		
-cement	$2{,}39 \times 10^{8}$	$2{,}29 \times 10^{7}$	$1{,}97 \times 10^{7}$	
-ceramic & sanitary			$3{,}65 \times 10^{6}$	

Comparison of the environmental impact of major construction material

ANALYSIS

When evaluated from the construcion energy needs

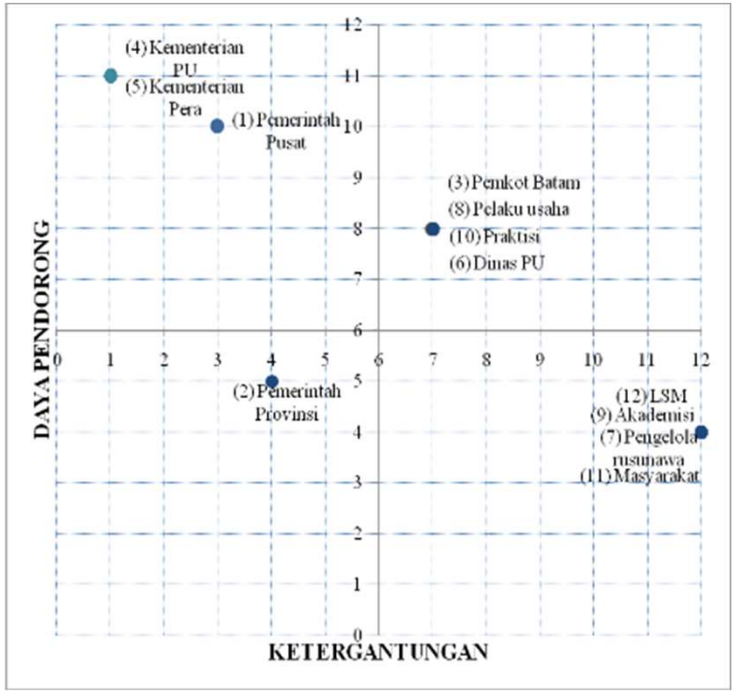
Convensional system 272 kWh/m2,
Full precast system 219 kWh/m2,
Half precast system yaitu 175 kWh/m2.

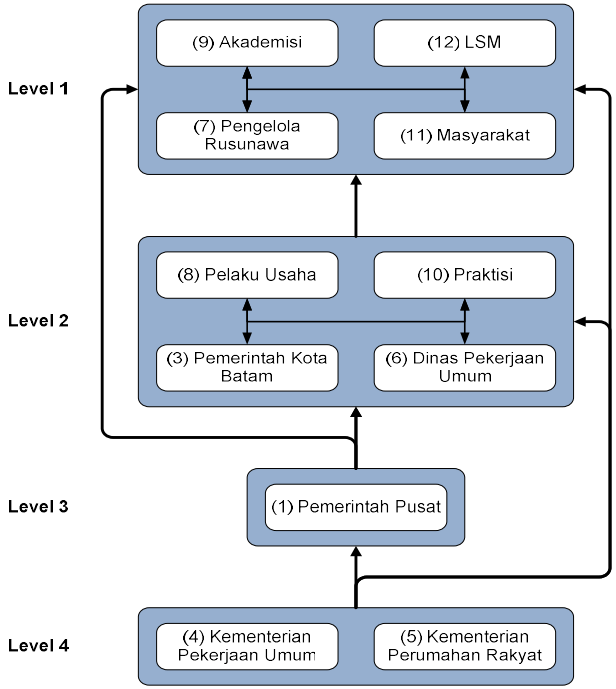
Energy needs are considered reasonable for the construction of residential buildings is 240 kWh/m2 that medium-rise apartment construction with precast system can be considered to meet the criteria of green construction.

RESULT AND ANALYSIS

ISM (Interpretive structural modelling)

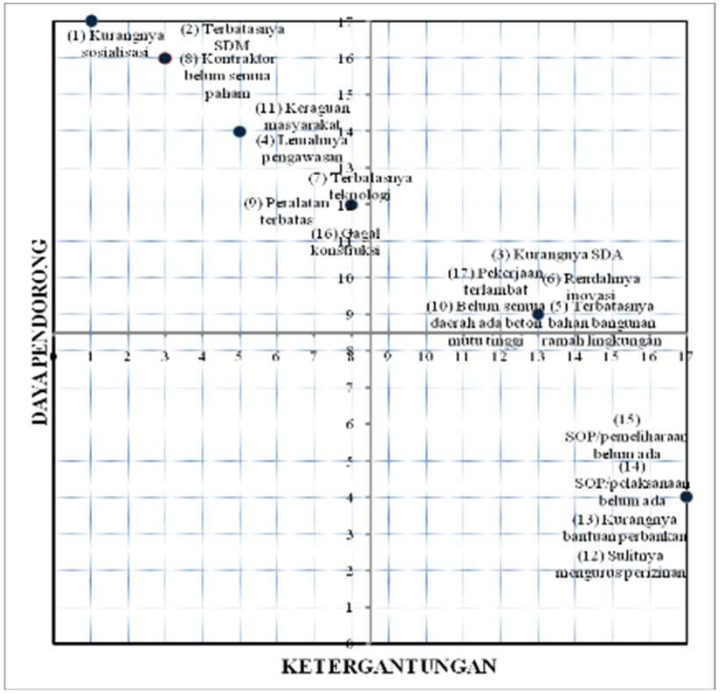
RESULT AND ANALYSIS





Based on the independence and the driving force (4) Ministry of Public Works and (5) Ministry of Housing as the most relevant sectors (key stakeholders), still has a driving force that is better than (1) the Central Government. Other groups occupy quadrant III (linkage) consists of: (3) Government of Batam, (6) Department of Public Works; (8) business, and (10) as a liaison practitioner..

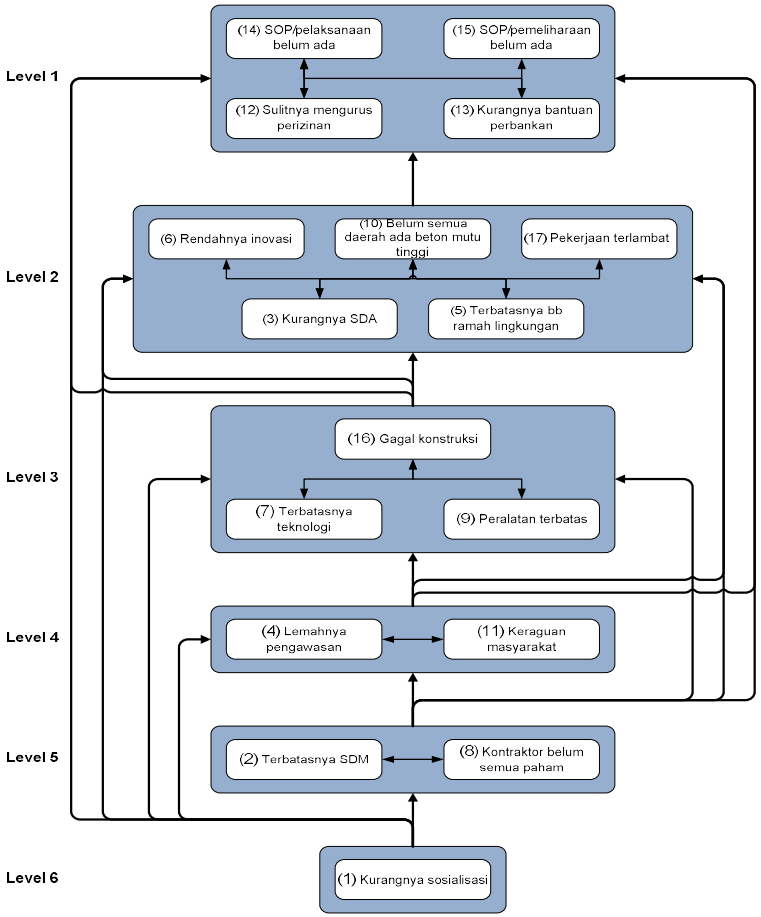
RESULT AND ANALYSIS



HANDI CAP

: (1) lack of socialization, (2) limited the quality of human resources; (8) not all contractors understand, (4) lack of oversight, and (11) doubt society, (7) lack of technology; (9) equipment limitations, and (16) failing construction.

RESULT AND ANALYSIS



Hierarchy Level on the Relation of Element of Main Handicap

: (1) lack of socialization, (2) limited the quality of human resources; (8) not all contractors understand, (4) lack of oversight, and (11) doubt society, (7) lack of technology; (9) equipment limitations, and (16) failing construction.

The Concept of Sustainable Low Cost Housing Policy

- LCA and ISM results become the foundation for preparing strategy of sustainable development Low Cost Housing policies.
- The main actors who must play a role is the Ministry of Public Works and the Ministry of Housing.
- Both of these institutions should encourage the development of Low Cost Housing primarily through socialization to enhance capabilities of human resources and understanding of all parties.
- In addition, there should be policies that could encourage the implementation priority for the half precast concrete construction for the successful development of environmentally friendly.

05 – GREEN BUILDING CODE IN INDONESIA

GREEN BUILDING CODE INDONESIA

MENTERI PEKERJAAN UMUM DAN PERUMAHAN RAKYAT
REPUBLIK INDONESIA

PERATURAN MENTERI PEKERJAAN UMUM DAN PERUMAHAN RAKYAT
REPUBLIK INDONESIA
NOMOR 21 TAHUN 2021
TENTANG
PENILAIAN KINERJA BANGUNAN GEDUNG HIJAU

DENGAN RAHMAT TUHAN YANG MAHA ESA

MENTERI PEKERJAAN UMUM DAN PERUMAHAN RAKYAT REPUBLIK INDONESIA,

Menimbang : bahwa untuk melaksanakan ketentuan Pasal 123 Peraturan Pemerintah Nomor 16 Tahun 2021 tentang Pelaksanaan Undang-Undang Nomor 28 Tahun 2002 tentang Bangunan Gedung perlu menetapkan Peraturan Menteri Pekerjaan Umum dan Perumahan Rakyat tentang Penilaian Kinerja Bangunan Gedung Hijau;

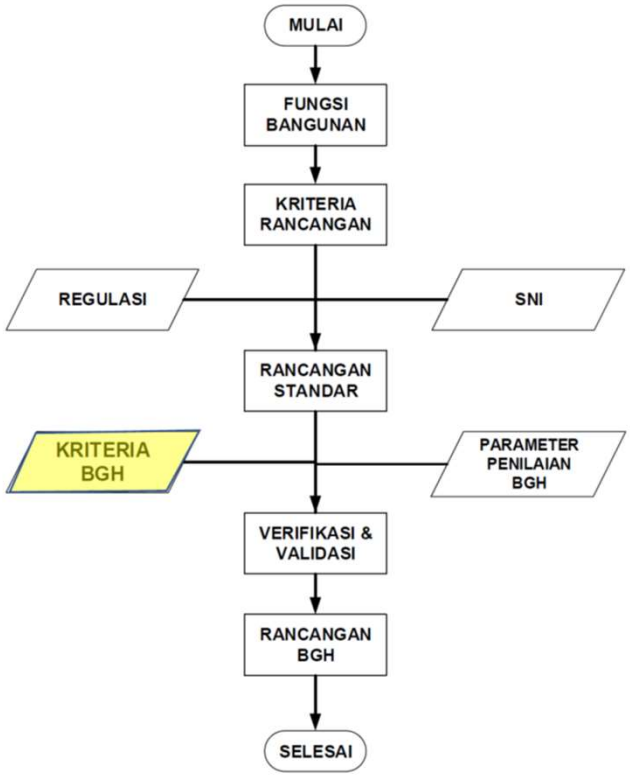
Mengingat :
1. Pasal 17 ayat (3) Undang-Undang Dasar Negara Republik Indonesia Tahun 1945;
2. Undang-Undang Nomor 28 Tahun 2002 tentang Bangunan Gedung (Lembaran Negara Republik Indonesia Tahun 2002 Nomor 134, Tambahan Lembaran Negara Republik Indonesia Nomor 4247);
3. Undang-Undang Nomor 39 Tahun 2008 tentang Kementerian Negara (Lembaran Negara Republik Indonesia Tahun 2008 Nomor 166, Tambahan Lembaran Negara Republik Indonesia Nomor 4916);

Mandatory in minimum category for all building construction : in building permit (Persetujuan Bangunan Gedung/PBG)

Mandatory in several category for goverment building

GREEN BUILDING CODE INDONESIA

KRITERIA BGH



Peraturan Menteri PUPR Nomor 21 Tahun 2021

KLAS BANGUNAN GEDUNG	DEFINISI	KATEGORI
Klas 1	Bangunan Gedung hunian biasa: Sub-klas 1a: Satu rumah tunggal, satu atau lebih rumah gandeng yang dipisahkan dinding tahan api Sub-klas 1b: Asrama, hostel atau sejenisnya dengan luas paling besar 300 m^2 dan tidak dihuni lebih dari 12 orang	DISARANKAN (*RECOMMENDED*)
Klas 2	Bangunan Gedung hunian yang terdiri atas 2 atau lebih unit hunian, yang masing-masing merupakan tempat tinggal terpisah	DISARANKAN (*RECOMMENDED*)
Klas 3	Bangunan Gedung hunian di luar klas 1 dan 2, yang umum digunakan sebagai tempat tinggal lama atau sementara oleh sejumlah orang yang tidak berhubungan	DISARANKAN (*RECOMMENDED*)
Klas 4 dengan ketentuan: - di bawah 3	Bangunan Gedung hunian yang berada di dalam suatu bangunan klas 5, 6, 7, 8, atau 9 dan merupakan tempat tinggal yang ada	DISARANKAN (*RECOMMENDED*)

GREEN BUILDING CODE INDONESIA

KRITERIA BGH

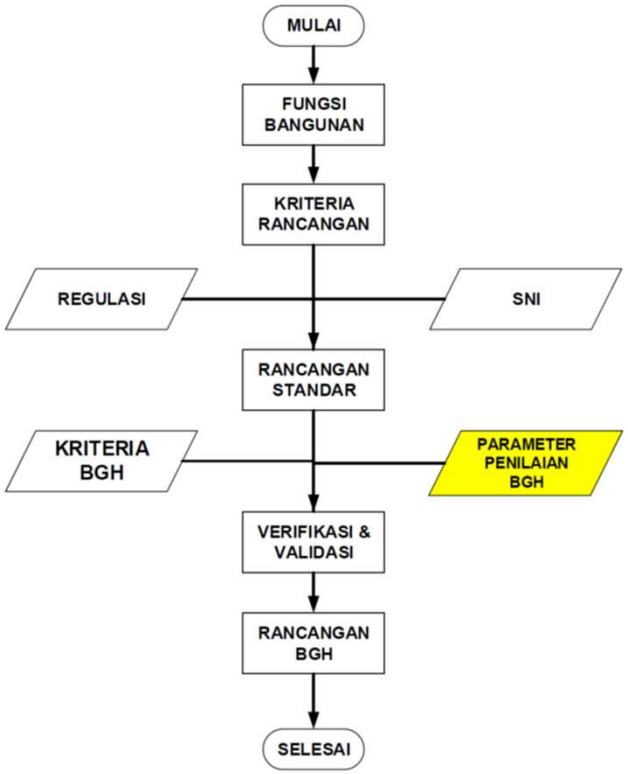
KLAS BANGUNAN GEDUNG	DEFINISI	KATEGORI
lantai; atau - di atas 4 lantai dengan luas kurang dari 50.000 m²	dalam bangunan tersebut	
Klas 5 dengan ketentuan: - di bawah 3 lantai; atau - di atas 4 lantai dengan luas kurang dari 50.000 m²	Bangunan Gedung yang dipergunakan untuk tujuan usaha profesional, pengurusan administrasi, atau usaha komersial, di luar bangunan klas 6, 7, 8, atau 9	DISARANKAN (*RECOMMENDED*)
Klas 6 dengan ketentuan: - di bawah 3 lantai; atau - di atas 4 lantai dengan luas kurang dari 5000 m2	Bangunan Gedung toko atau Bangunan Gedung lain yang dipergunakan untuk tempat penjualan barang-barang secara eceran atau pelayanan kebutuhan langsung kepada masyarakat	DISARANKAN (*RECOMMENDED*)
Klas 7 dengan ketentuan: - di bawah 3 lantai; atau - di atas 4 lantai dengan luas kurang dari 5000 m²	Bangunan Gedung yang dipergunakan sebagai penyimpanan	DISARANKAN (*RECOMMENDED*)
Klas 8 dengan ketentuan: - di bawah 3 lantai; atau - di atas 4 lantai dengan luas kurang dari 5000 m²	Bangunan Gedung laboratorium dan Bangunan Gedung yang dipergunakan untuk tempat pemrosesan suatu produksi, perakitan, perubahan, perbaikan, pengepakan, *finishing*, atau pembersihan barang-barang produksi dalam rangka perdagangan atau penjualan	DISARANKAN (*RECOMMENDED*)

Peraturan Menteri PUPR Nomor 21 Tahun 2021

KLAS BANGUNAN GEDUNG	DEFINISI	KATEGORI
Klas 9a dengan ketentuan luas sampai dengan 20.000 m²	Bangunan Gedung umum untuk pelayanan perawatan kesehatan	DISARANKAN (*RECOMMENDED*)
Klas 9b dengan ketentuan luas sampai dengan 10.000 m²	9b. Bangunan Gedung umum pertemuan yang tidak termasuk setiap bagian dari bangunan yang merupakan klas lain	DISARANKAN (*RECOMMENDED*)
Klas 10	Sub-klas 10b: Bangunan Gedung bukan hunian berupa sarana atau prasarana yang dibangun terpisah Sub-klas 10a: Struktur berupa sarana atau prasarana yang dibangun terpisah	DISARANKAN *(RECOMMENDED)*

GREEN BUILDING CODE INDONESIA

PARAMETER PENILAIAN BGH



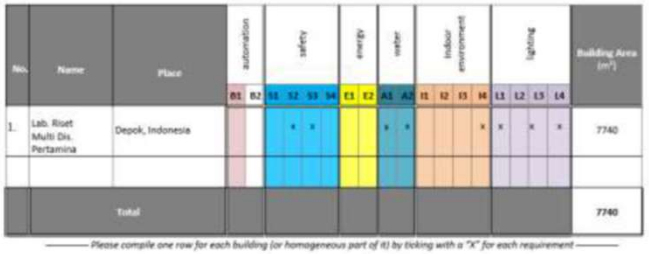
Peraturan Menteri PUPR Nomor 21 Tahun 2021

- Pengelolaan Tapak – 9 Parameter
- Efisiensi Penggunaan Energi – 7 Parameter
- Efisiensi Penggunaan Air – 3 Parameter
- Kualitas Udara dalam Gedung – 3 Parameter
- Material Ramah Lingkungan – 2 Parameter
- Pengelolaan Sampah – 3 Parameter
- Pengelolaan Air Limbah – 2 Parameter

GREEN BUILDING CODE INDONESIA

VERIFIKASI & VALIDASI

- Ada parameter yang spesifik
- Ada dukungan referensi
- Ada analisis perhitungan
- Ada implementasi dalam gambar rancangan
- Ada dalam spesifikasi teknis



No.	Name	Place	automation	safety				energy		water		indoor environment				lighting				Building Area (m^2)
			B1	B2	S1	S2	S3	S4	E1	E2	A1	A2	I1	I2	I3	I4	L1	L2	L3	L4	
1.	Lab. Riset Multi Dis. Pertamina	Depok, Indonesia				x	x				x	x				x	x		x	x	7740
	Total																				7740

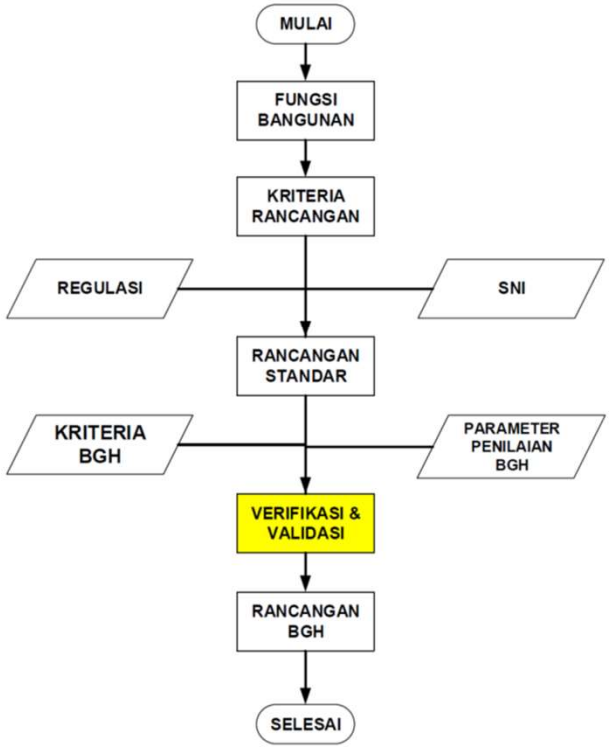
Please compile one row for each building (or homogeneous part of it) by ticking with a "X" for each requirement

Implementasi *Smart building*

$$\frac{total\ smart\ building\ area}{total\ building\ area} \times 100\%$$

Contoh:
***Total Area Gedung: 32140 m²**

$$\frac{7740\ m^2}{86431\ m^2} \times 100\% = 8\%$$



GREEN BUILDING CODE INDONESIA

BENTUK VERIFIKASI & VALIDASI

ANALISIS KUANTITATIF
(PERHITUNGAN & GAMBAR)

Kriteria

REGULASI DAN/ATAU SNI

Acuan

DUKUNGAN DOKUMEN
(RKS, GAMBAR, BROSUR)

Peraturan Menteri PUPR
Nomor 21 Tahun 2021

TAMPILKAN SE
86/DJ/CK/2016

B	**EFISIENSI PENGGUNAAN ENERGI**		Point Tersedia
	1. Selubung Bangunan		
	a. Selubung bangunan memiliki nilai akumulasi OTTV dan RTTV maksimum 35 Watt/m²	5	
	b. Nilai perbandingan selubung bangunan transparan dengan selubung bangunan masif (Window to Wall Ratio) kurang dari 30%	4	
	c. Penggunaan bahan selubung bangunan dapat mendukung efisiensi energi	3	
	TOTAL POIN	**12**	

JIKA MASIH DALAM BENTUK RENCANA TINDAK → DUKUNGAN KOMITMEN BERUPA SURAT PERNYATAAN

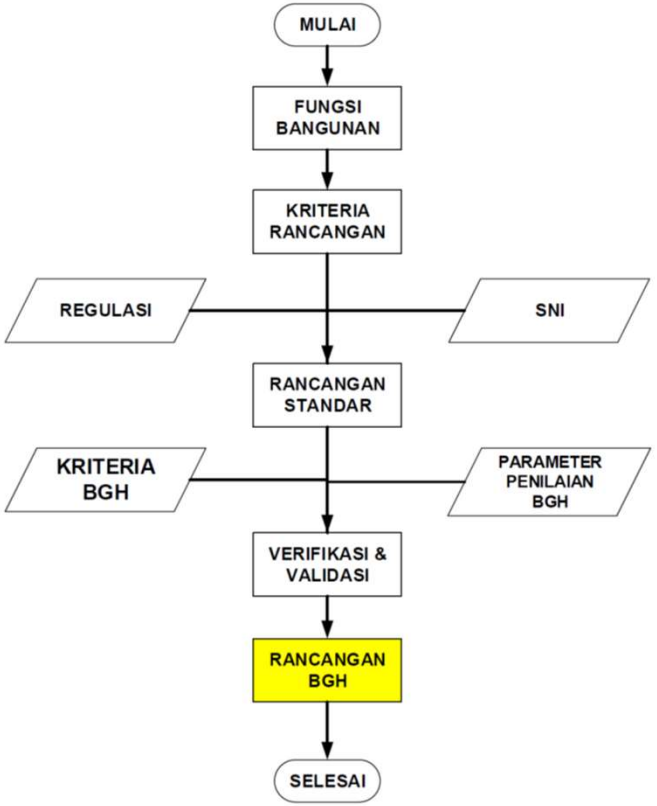
GREEN BUILDING CODE INDONESIA

RANCANGAN BANGUNAN GEDUNG HIJAU

Peraturan Menteri PUPR Nomor 21 Tahun 2021

- Memenuhi Kinerja Penilaian:
  - BGH Pratama - 45% - 65%
  - BGH Madya - 65% - 80%
  - BGH Utama - 80% - 100%
- Memiliki SLF

SERTIFIKAT LAIK FUNGSI



06 – CONCLUSION

CONCLUSION

Sustainable construction is a topic that emerges in the world construction as a respond to climate change issue.

Precast concrete is a construction system that meets green construction criteria

Precast building in Indonesia started to be applied commonly in government mass rental low-cost housing program (1995).

Qualitative research was conducted on the assessment criteria of Green Building Council of Indonesia (2012-2014) support precast in which the main principle is 3R (reduce, reuse, and recycle).

CONCLUSION

The quantitative researches were in energy consumption and environmental influence of several construction in Batam (2011-2012), which showed precast system is have less energy consumed and more environmental friendly than conventional system.

High performance earthquake resistant precast concrete structure at low cost (2013-2014) had found specific system configuration based on local available material and technology.

Based on the successfully application, Indonesian government had set the target application of precast concrete about 30% of construction industry until 2019.

CONCLUSION

The result of this research is expected to be a contribution to all construction stakeholder, in order to start to consider optimization of energy consumption and environmental impact in construction and to become part of sustainable earth movement.

Indonesia already have Green Building Code that mandatory for minimum category for general building and several category for government building