Sustainable Construction: Managing Construction Waste

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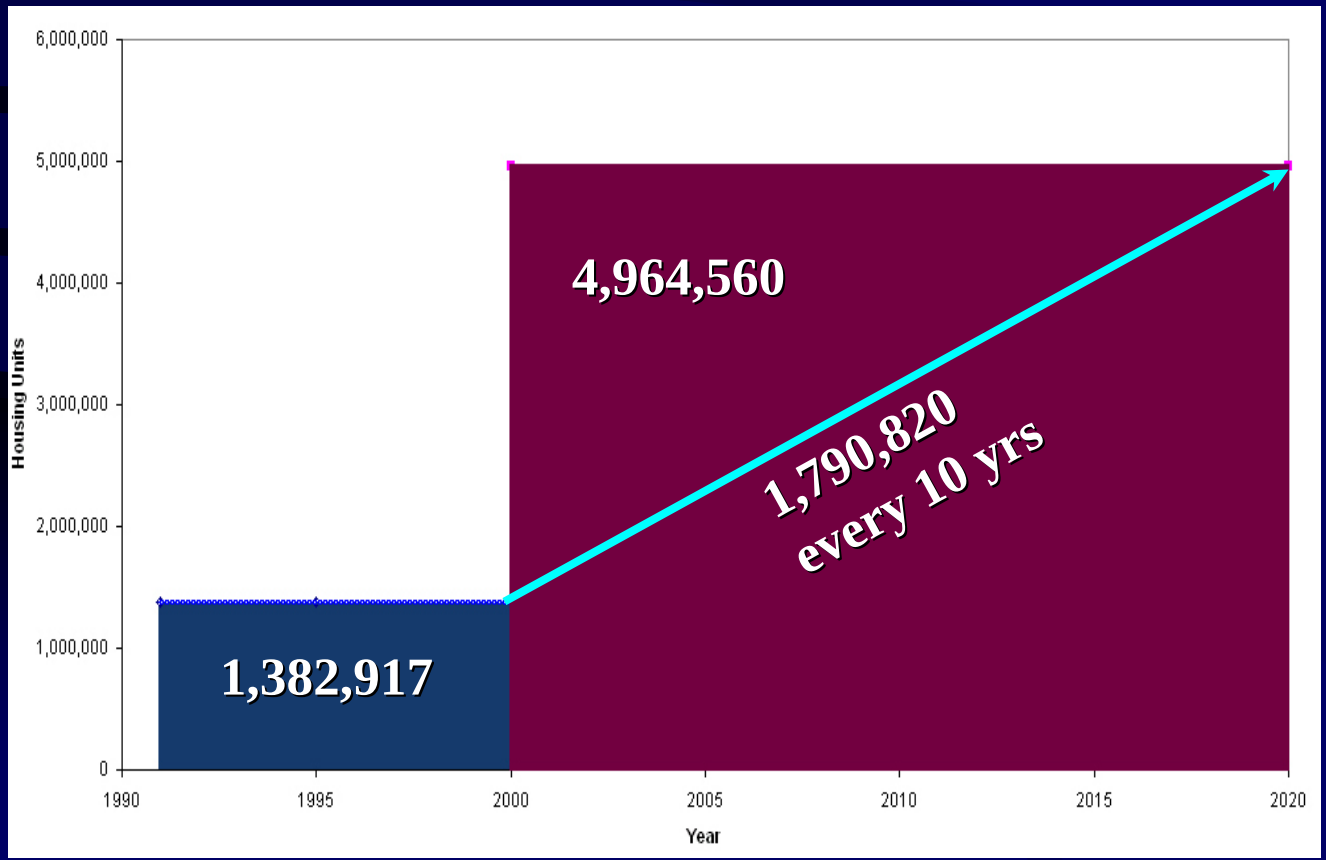
Introduction

Future Requirements:

- Rural & Urban Housing (RMK-9 RM 9.5 billion)

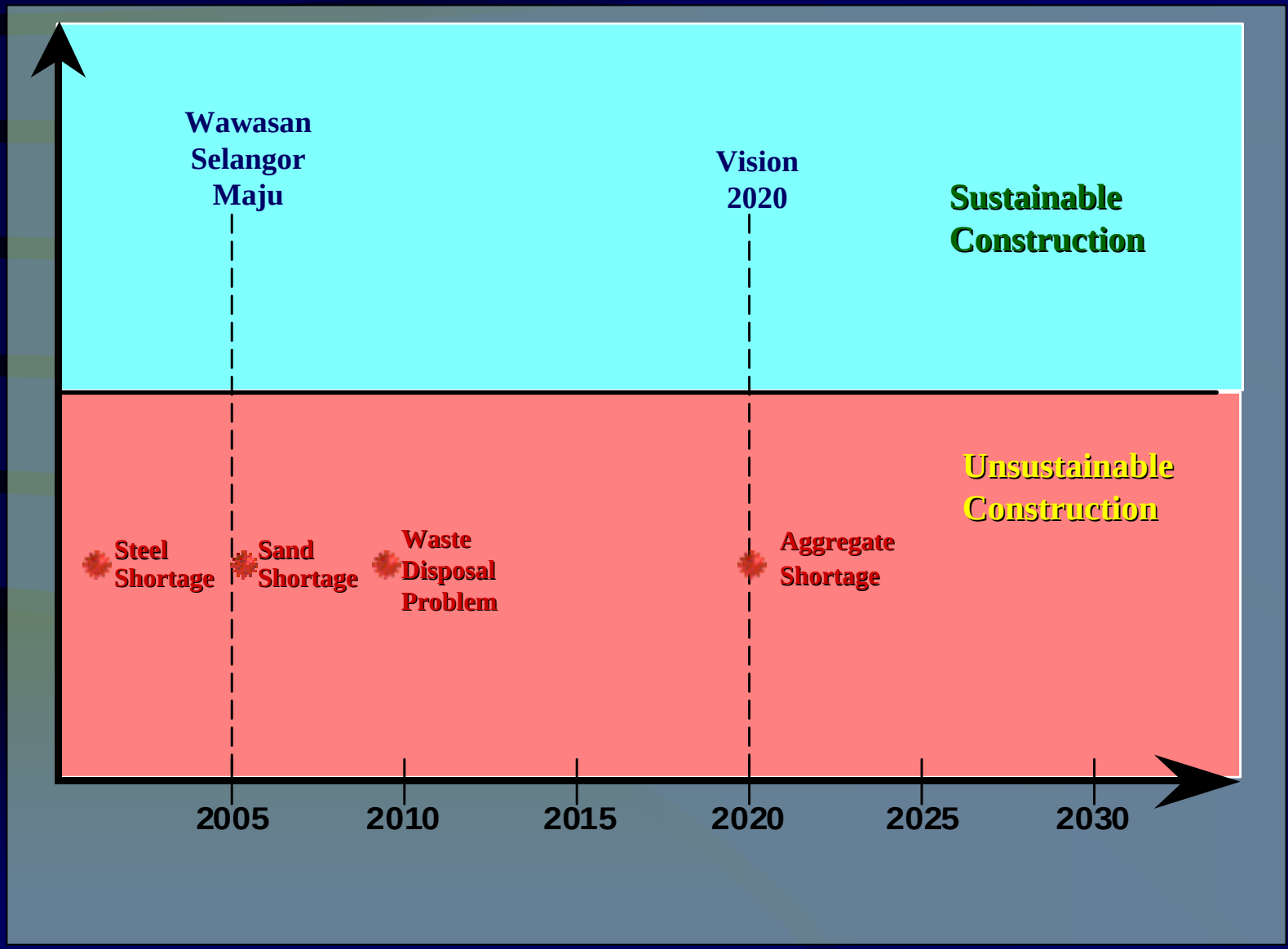


Source: RMK9

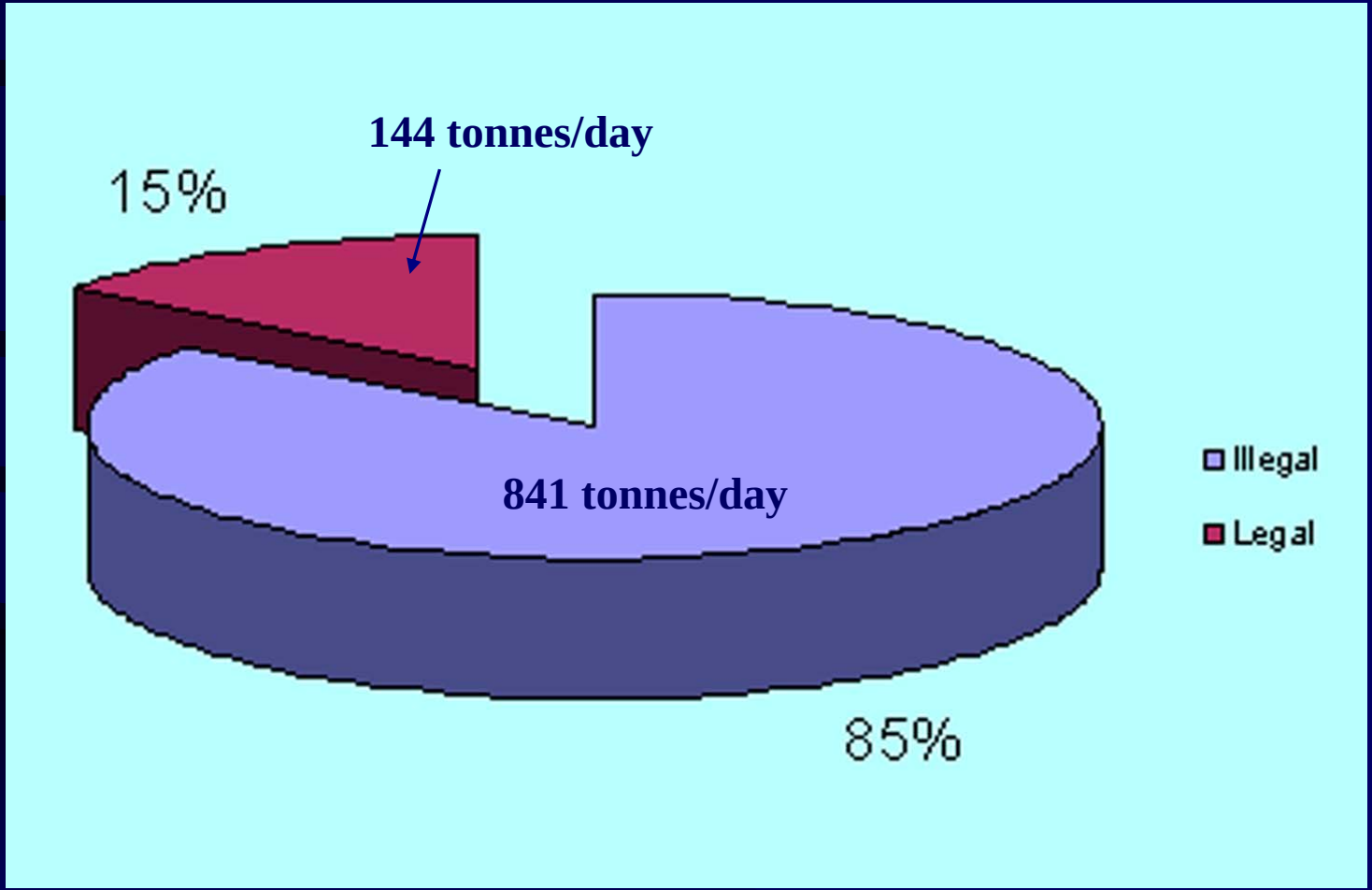
Conventional Method

- Labour Intensive
- Uses More Construction Materials
- Longer Time
- Dirty / Generates Waste
- Delays

Future Scenario : Materials and Waste



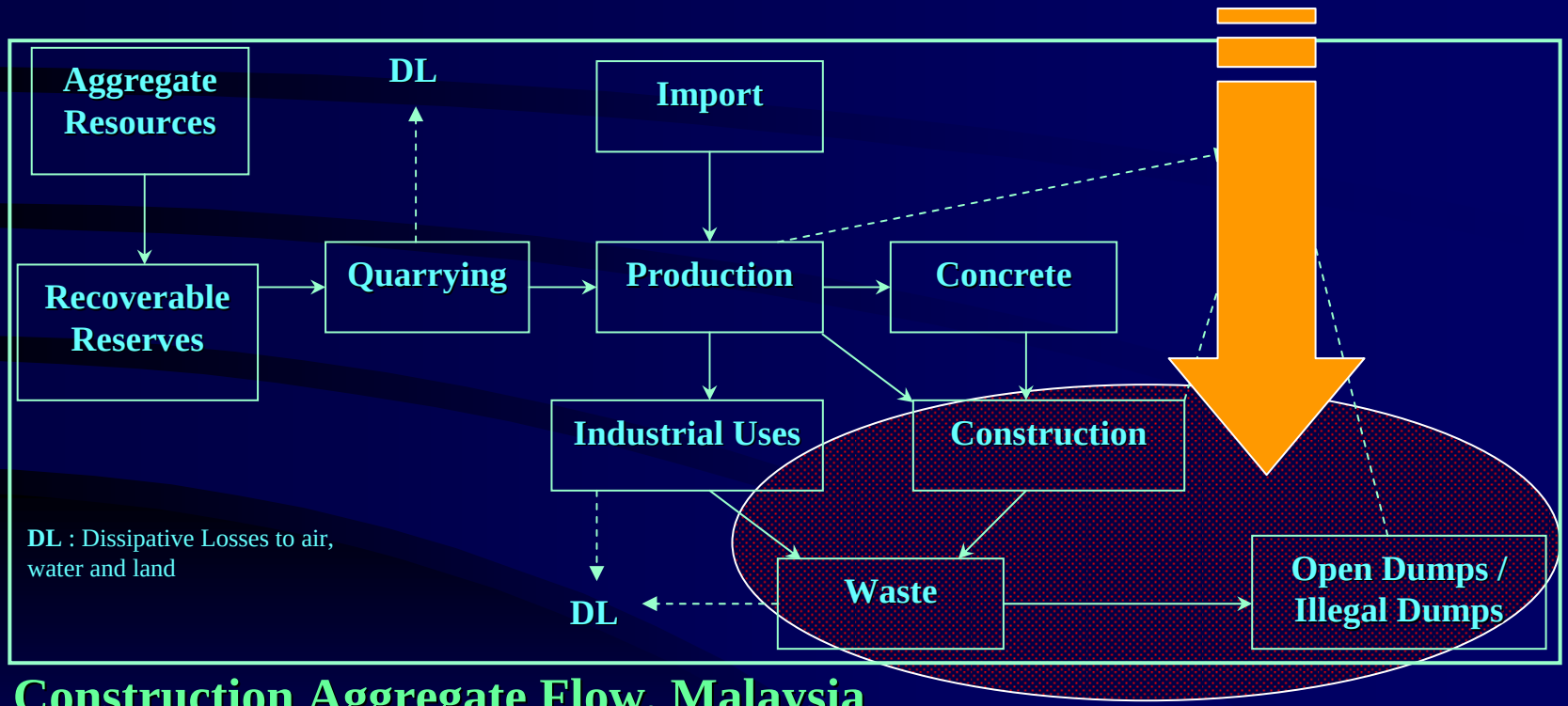
Waste from Conventional Method



Aggregate Flows

- Absence of Recycling

NOT A CLOSED LOOP!



Construction Aggregate Flow, Malaysia

- Not known how much is actually generated in IBS

Issues

STEEL

- Shortage – Losses RM 7.4 my a day

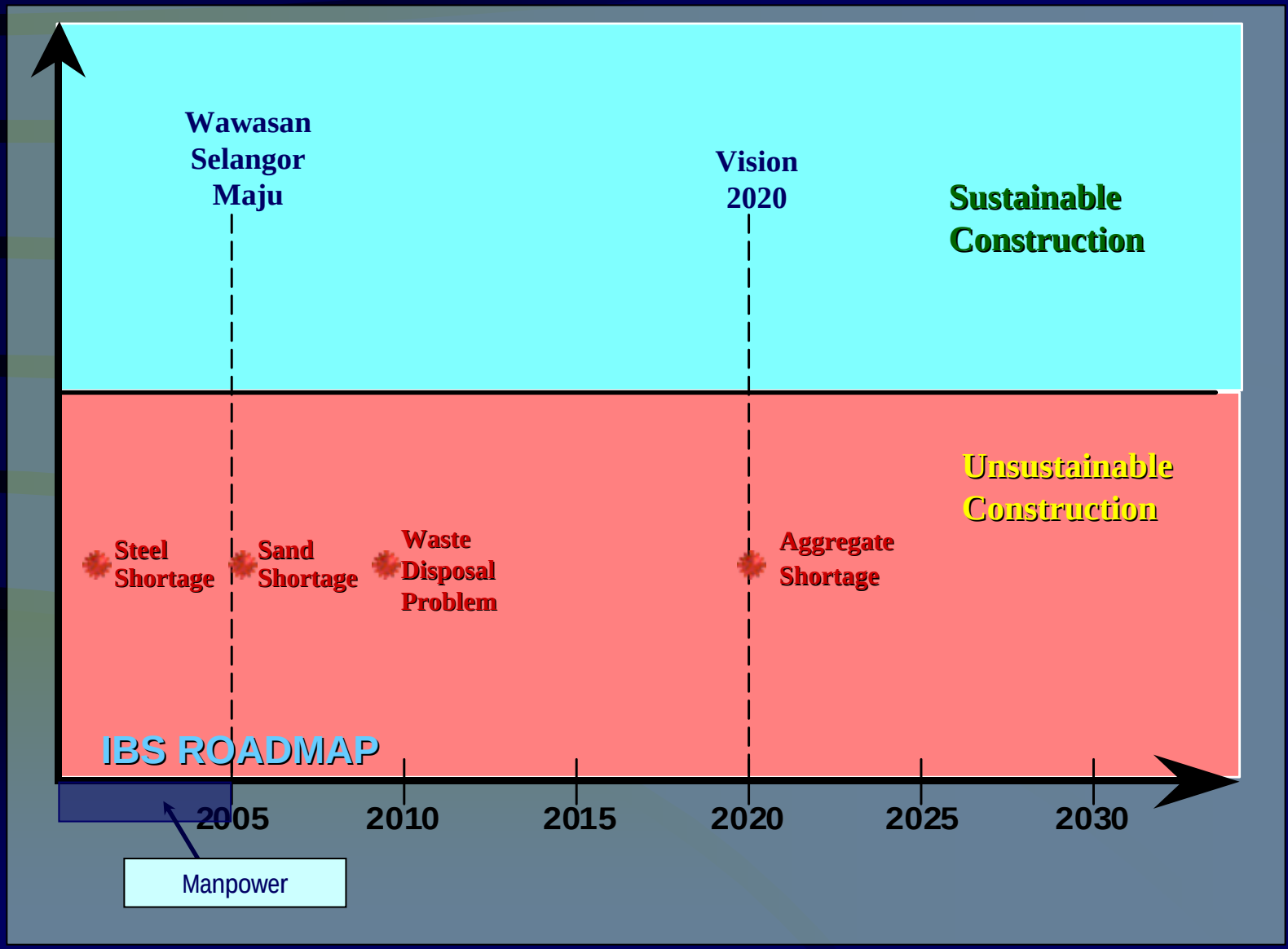
SAND

- Shortage of legal sand resources
- Banning of off-shore sand mining
- Increased illegal sand mining

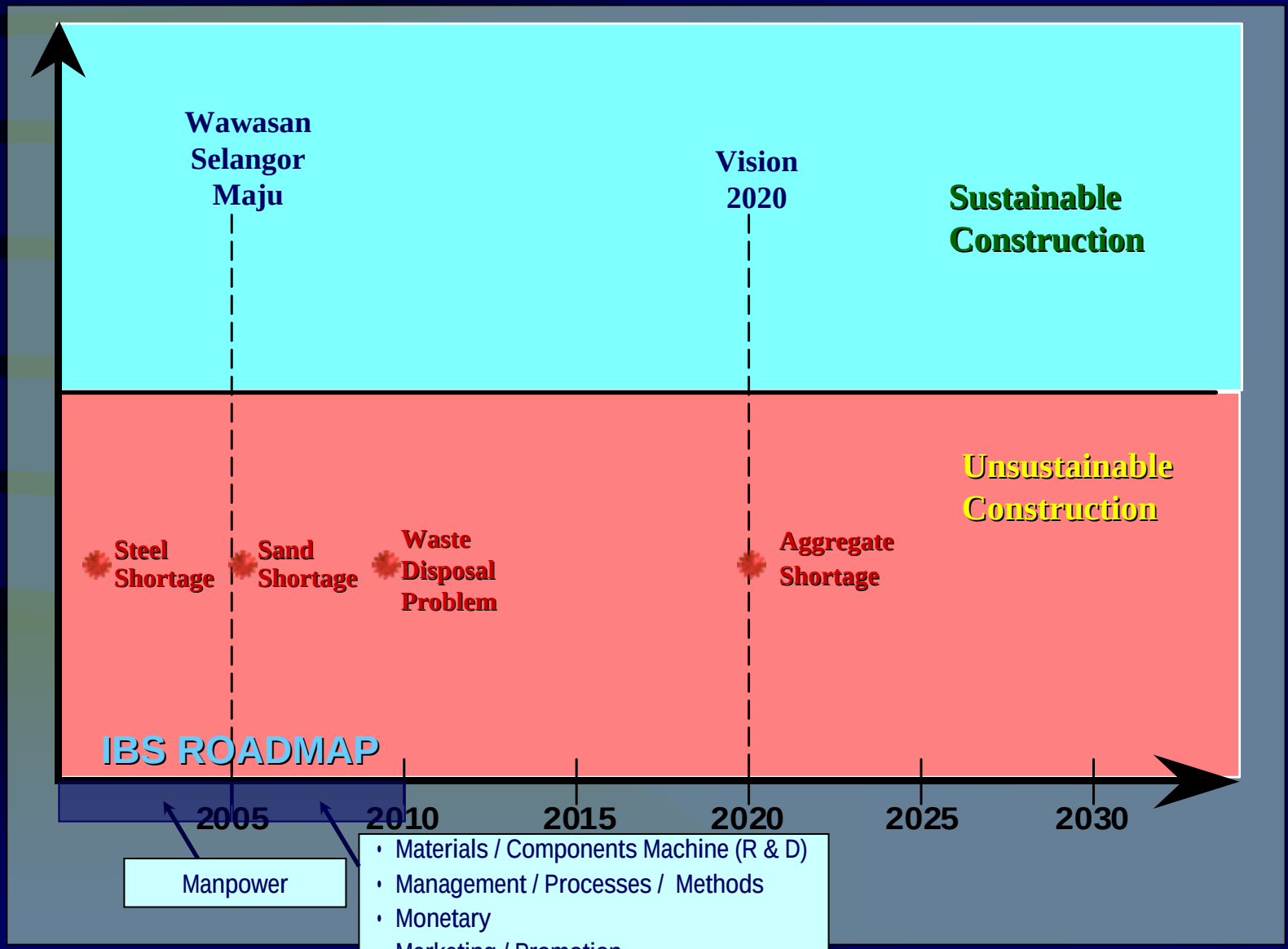
AGGREGATES

- Sterilization
- Lack of Recycling

Future Scenario : Materials and Waste



Future Scenario : Materials and Waste



Targeted usage of IBS in Government building projects

Year	Targeted Usage of IBS (%)
2005	40
2006	50
2007	60
2008	70
2009	80
2010	90

Source: IBS RoadMap, 2003-2010

GOAL

Successful transformation from conventional methods to IBS

- Meeting set targets
- Create a resilient construction sector
  - Generate less waste (more reduce, reuse & recycle)
  - Redesign for zero waste (DFE approach)
  - Efficient & effective material cost management
  - Optimum usage of local non-renewable resources
  - Extend the supply chain (create local IBS clusters)

Constraints

- Limited projections on minerals availability for construction sector
- No agency or project investigating IBS waste management cycle; from source to disposal

Requirements

- Develop a forecasting technique to assess resource needs and optimisation for IBS
- Develop a routine reporting framework on availability of non-renewable resource

Proposed Project Objectives

- To assess the long-term availability of materials from non-renewable resources for IBS and its relationship to supply and costs
- To evaluate the amount of waste generated using IBS as compared to conventional methods
- To examine “design for environment’ (DFE) approaches with a view to optimise non-renewable material consumption and reduce wastage (aim for zero waste)

Direct Beneficiaries

- CIDB – Improved planning, cost projections and waste management for IBS
- KPKT & REHDA – Ability to maintain optimum cost of housing in the long-term
- MBAM – improved projections, materials and waste management among contractors
- Minerals & Geoscience Department (JMG) – Improved mineral resource management in conjunction with CIDB and State Governments

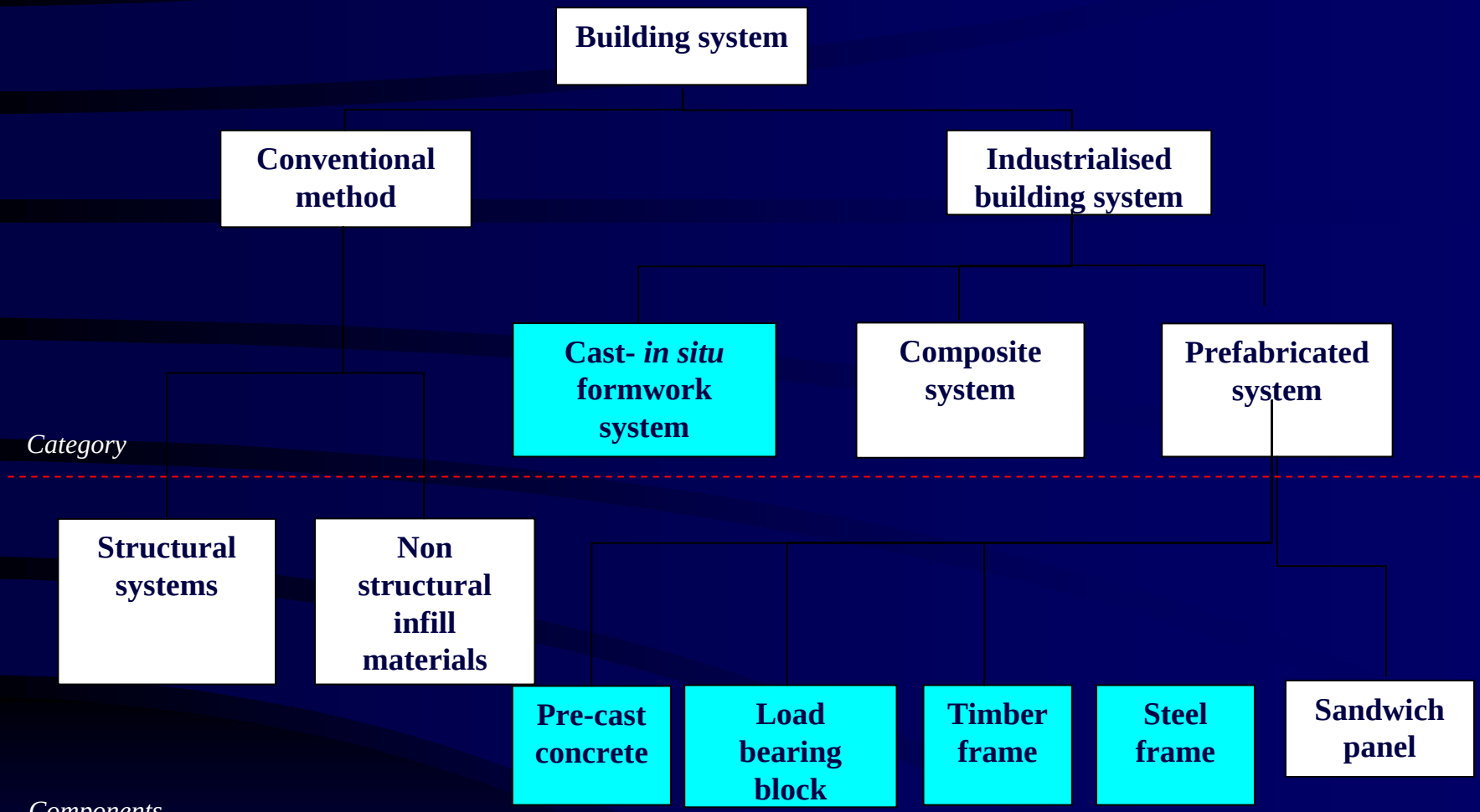
Definition of Industrialised Building Systems (IBS)

Industrialised building system (IBS) is the total integration of all subsystems and components into an overall process fully utilizing industrialised production, transportation, and assembly techniques (Dietz, A.G.H, 1971). This integration is achieved through the exploitation of the underlying organizational principles rather than the external forms of industrialisation, mechanization and programming to structure the entire building process. Meanwhile, CIDB through an IBS Survey 2003 has defined the industrialized building system as a construction system in which components are manufactured in a factory, on or off-site, positioned and assembled into a structure with minimal additional site works. In addition, Trikha and Abang Abdullah (2004) and W.H Wan Badaruzaman (2003) emphasised on the usage of mechanical equipment for the erection and assembly of the building components.

IBS involves an industrialised process by which components of a building are conceived, planned, fabricated, transported and erected onsite (Syed Mansur, 1986). The success of the industrialisation depends on the balanced combination between the software and hardware elements of the systems used. Software elements are related to the process of the total coordination and the management of industrialised building system whereas, the hardware elements relate to the nuts and bolts of the building systems.

Definition of IBS for the research project

The research project has define a comprehensive definition of IBS as a construction system with total intergration of all sub-systems and components, modular coordination for building systems with computer aided design and manufacturing, standardisation, fully utilizing industrialised production on or off-site, assembly techniques and positioned into a structure by machineries or done manually. Therefore, the use of IBS leads to minimal in-situ construction, un-skilled labour usage, mass production and systematic quality control.



The categories and components of IBS (Modified **from Badir and Razali, 1998 in Badir et al. 2002)**

Types of IBS (CIDB 2003)

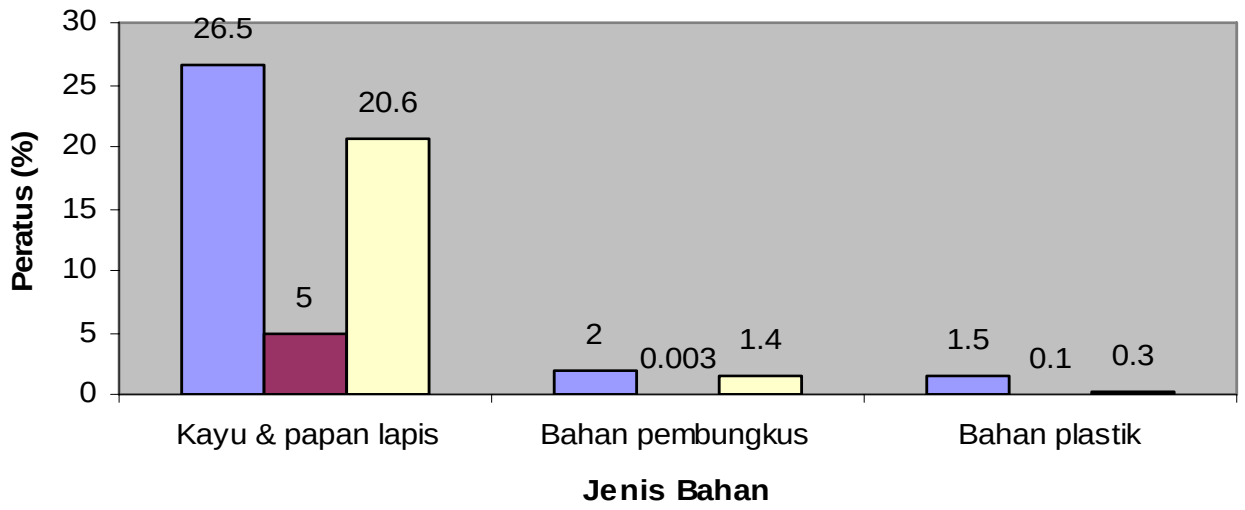
Categories of Building Systems

	Components	Types	Practices in Malaysia
Category I : Conventional	Structural system	Reinforced concrete frames	Timber formwork
	Non-structural infill materials	Brick and plaster	Brick and plaster
Category II : Mixed	Formwork system	Lightweight prefabricated formwork	• modular moulding form • column and beam form • tunnel form • permanent formwork
	Composite system	Assembly of pre-cast elements	Pre-cast floor, hollow core slab, in-filled wall, pre-cast staircases, bathrooms
Category III : IBS	Prefabricated system - onsite	Floor and roof slab, column and jacking	Floor and roof slab, column and jacking
		Precast concrete	Precast wall panel
	Prefabricated system - offsite	Precast concrete-frame, panel, box	• precast frame • precast wall panel
		Load bearing block	Load bearing block panel
		Sandwich panel	Load bearing sandwich panel
		Timber frame	Timber frame
		Steel frame	Steel frame

Project Case Studies

	Category I (Conventional)	Category II (Mixed)	Category III (IBS)
1	Casa Desa Apartments, Jalan Klang Lama	Precinct 18R8, Putrajaya. (Apartments)	Parcel 7, Precinct 9, Putrajaya (Apartments)
2	Precinct 18R4, Putrajaya. (Apartments)	Precinct 14-12, Putrajaya. (Apartments)	Parcel 10, Precinct 9, Putrajaya (Apartments)
3	Kamsis H, UKM Bangi, Bandar Baru Bangi	Precinct 5R4 Putrajaya, (Apartments)	-

Kategori I: Sisa Binaan Bukan Mineral



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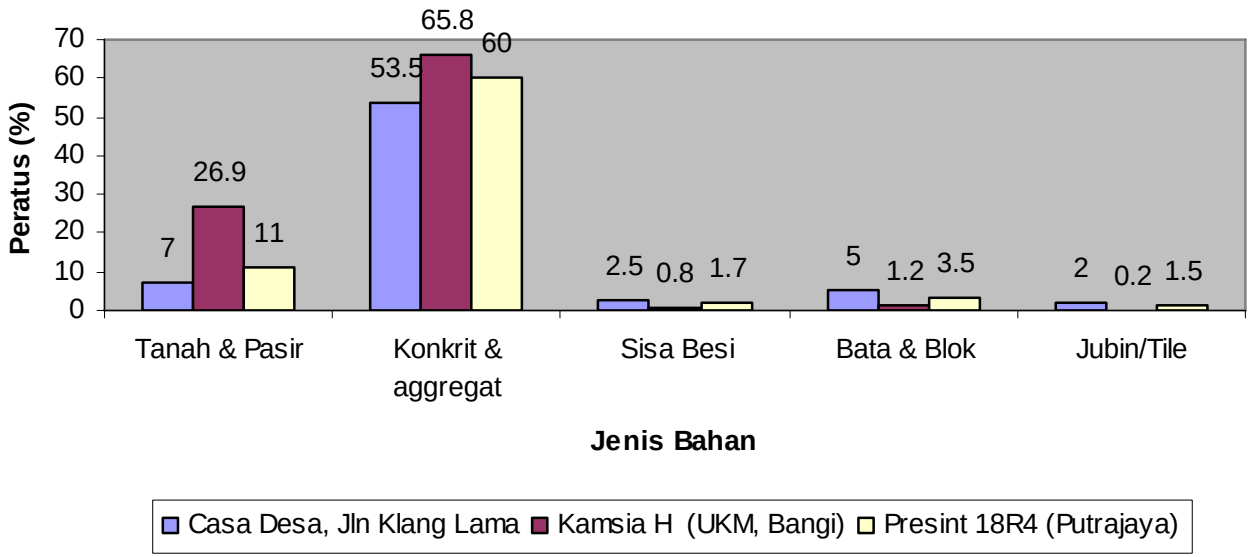
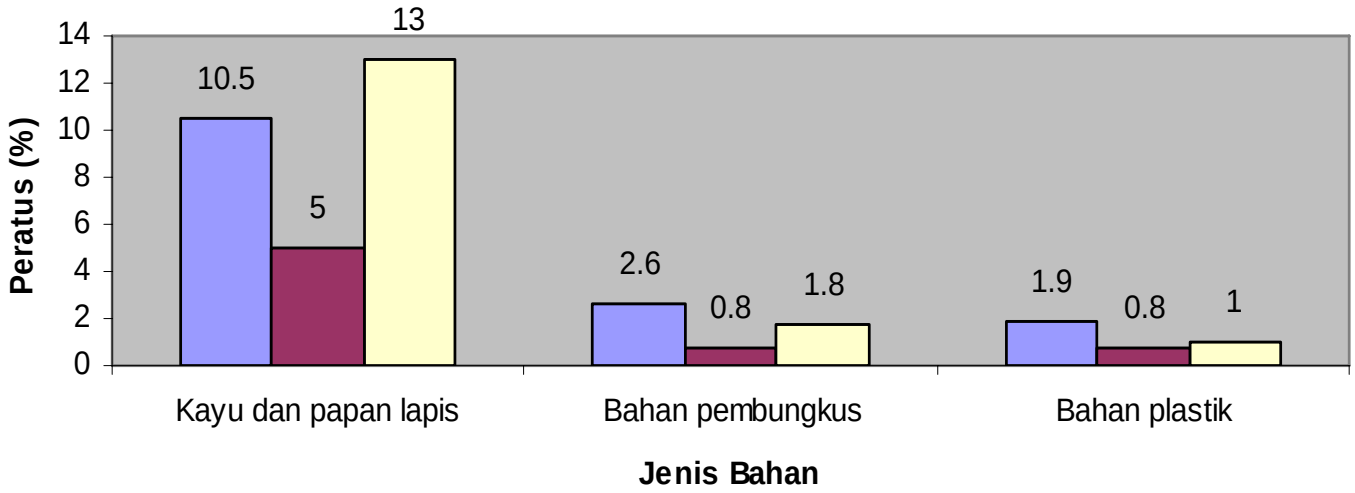


Kategori II: Sisa Binaan Bukan Mineral



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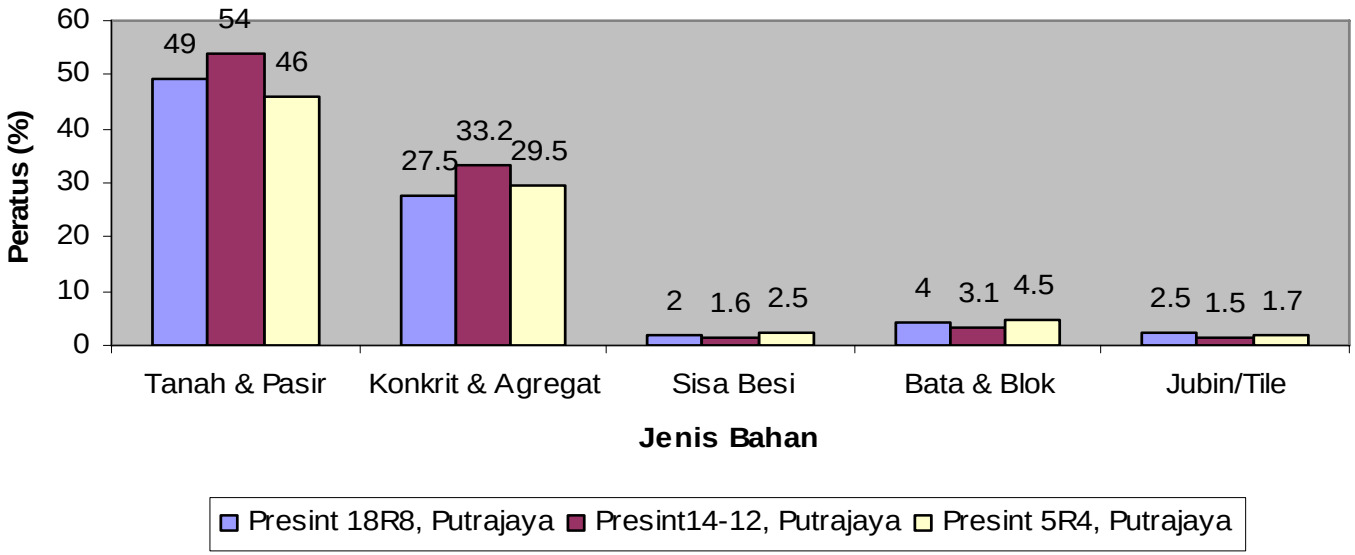
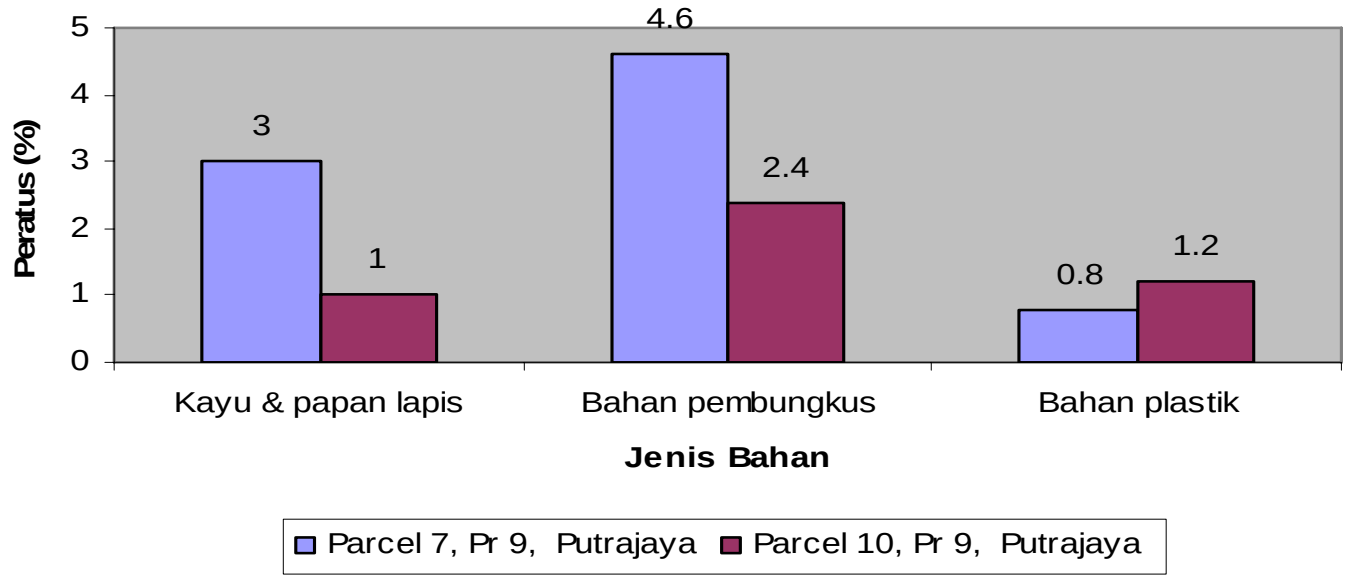


Kategori III: Sisa Binaan Bukan Mineral



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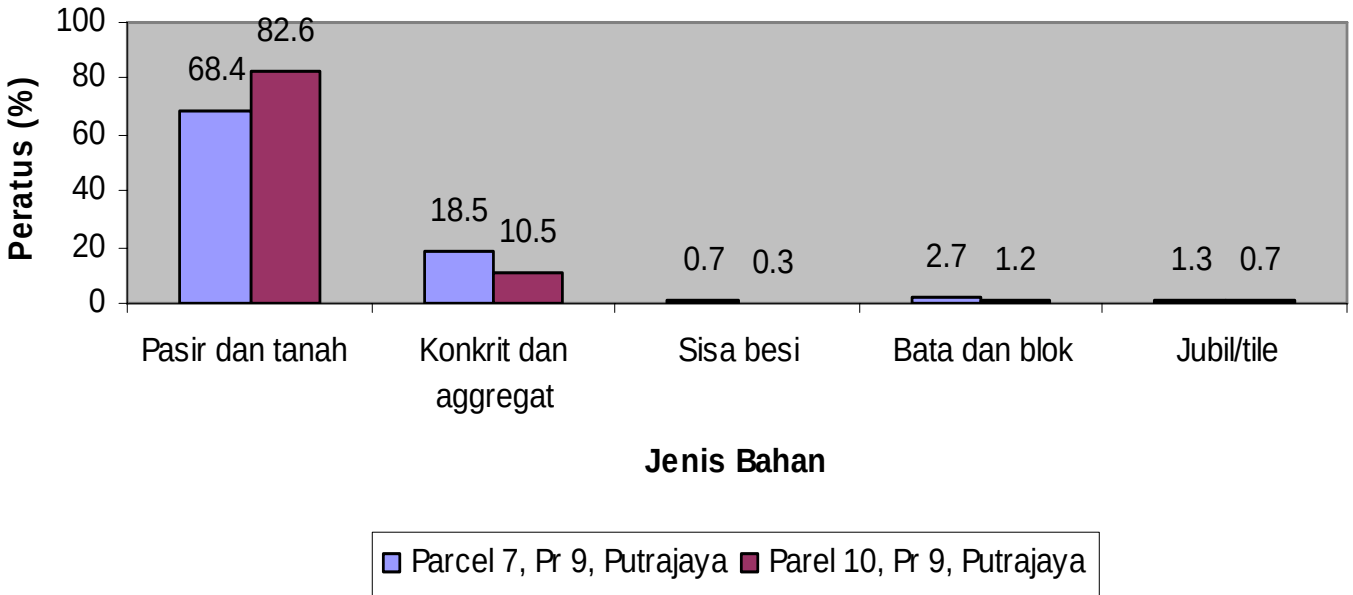

Waste Generation and Composition: Comparison Between an IBS (Parcel 7, Presint 9, Putrajaya) and a Conventional Project (Kamsis H, UKM). Based on 100 square m floor space

Construction Waste Materials	Amount of Waste Generated by Weight (Tonnes)	
	Fully Prefabricated	Conventional
Soil and sand	1.01	14.7
Brick and blocks	0.04	0.63
Concrete and aggregate	0.27	36.0
Tiles	o.o2	2.72
Scrap metal	0.01	0.45
Wood	0.04	0.11
Plastic materials	0.01	0.03
Packaging products	0.07	0.002
Total	1.47	54.642

Source: LESTARI, 2009

Reused and Recycled Waste Materials: : Comparison an IBS (Parcel 7, Presint 9, Putrajaya) and a Conventional Project (Kamsis H, UKM). Based on Total Waste Generation at the site.

Construction Waste Materials	Amount of Reused and Recycled by Weight (Tonnes)	
	Fully prefabricated (116,666 m2)	Conventional (49662 m2)
Soil	1,095	5400
Sand	86.5	
Concrete & aggregate	320	13365
Scrap Metal	12.1	54
Brick & Blocks	42.03	126
Roofing Materials (Tiles)	22.5	5.4
Wood	51.9	810
Total Amount of Reused and Recycled	1,630.03	19760.4
Total Waste Generation based on gross floor space	1729.70	27068.4
Percentage of Reused and Recycled	94.24	73.0

Source: LESTARI, 2009

Cost Savings : Comparison of an IBS (Parcel 7, Presint 9, Putrajaya) and a Conventional Project (Khamsis H, UKM).

Category	Percentage of Cost Savings*	
	On Site	Off Site
Conventional	2.5%	Not Relevant
IBS	0.035%	?

* In terms of Net Benefit (TB – TC) and Total Project Value

Source: LESTARI, 2009

THANK YOU