

Masa Depan Revolusi Beton Ramah Lingkungan



The Art of Lightweight Technology





Peduli & Antusias

Limbah Industri dan Perubahan Iklim telah menjadi topik yang sangat utama yang mempengaruhi semua aspek kehidupan mulai dari Geopolitik hingga Ekonomi hingga Migrasi.

Para Pemimpin Dunia telah mengusahakan solusi terbaik untuk menangani pemanasan global dan dekarbonisasi untuk mencapai Lingkungan yang lebih baik bagi bumi kita

Litbang Gramata telah melakukan riset lebih dari tujuh tahun untuk menemukan mendaur ulang limbah Industri seperti limbah sisa abu pembakaran batu bara yang mengandung logam dan toksisitas tinggi untuk dikonversi menjadi netral dan Aman bagi umat manusia.

Gramata telah mengubah bahan Limbah anorganik seperti menjadi Agregat Hijau Ringan Struktural dan Non Struktural (LiGrA) baru dari Limbah Anorganik seperti kaca, Lumpur Merah, Tanah Liat, Keramik, Puing Pembongkaran Bangunan, dll menjadi Agregat Ramah Lingkungan Struktural dan Non-Struktural (LiGrA). Inovasi material ramah lingkungan ini memberikan sumbangsih yang revolusioner bagi industri beton dan industri lainnya dengan mengurangi biaya pondasi, meningkatkan rentang kolom, meningkatkan penahanan, Meningkatkan insulasi panas selain menghemat biaya logistik dan transportasi secara tidak langsung, sekaligus menghemat energi Fosil dan mendukung kelestarian lingkungan.

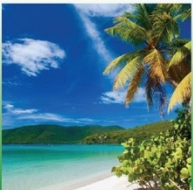
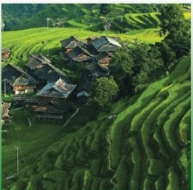
Mendaur ulang bahan limbah dan membuat bahan ramah lingkungan yang konsisten untuk masa depan adalah tanggung jawab pelaku industri konstruksi. Inovasi dan pengelolaan Limbah yang kreatif akan mendorong setiap negara menuju "bebas limbah" dan mencapai negara "hijau" sebagai ekosistem kehidupan yang lebih baik untuk generasi berikutnya.

Boediman WIDJAJA, MBA
Pendiri dan CEO JOE Green Group



"Menciptakan dan Mengembangkan bahan baku agregat ringan yang ramah lingkungan dari limbah konstruksi yang turut mendukung tantangan iklim global untuk membangun masa depan yang berkesinambungan."

MENUJU HIJAU  MENUJU GLOBAL



Menurut Bank Dunia:

2,24 miliar ton sampah padat pada tahun 2020

Menurut Journal of Science, NATURE:

30 miliar ton Beton digunakan setiap tahun.

Bagaimana cara mendaur ulang limbah pada Beton?

Jawabannya adalah  LiGrA™
Green Aggregates



Tanpa Limbah

LiGrA™
Lightweight Green Aggregates

DAMPAK SOSIAL DAN EKONOMI DARI EMISI KARBON



Biaya penyesuaian daerah pantai karena naiknya permukaan laut



Penurunan kapasitas kerja akibat suhu pemanasan global



Perang untuk memperebutkan sumber daya yang terbatas



Kekurangan sumber air di beberapa area



Relokasi seluruh kota



Menyusutnya hasil panen



Naiknya harga bahan makanan & barang konsumsi



Fenomena meteorologi yang ekstrem akan menyebabkan naiknya tingkat kemiskinan



Banyak penyakit menyebar karena naiknya suhu bumi



Coal Bottom Ash



Marine Clay



Demolition Waste



Bauxite Waste



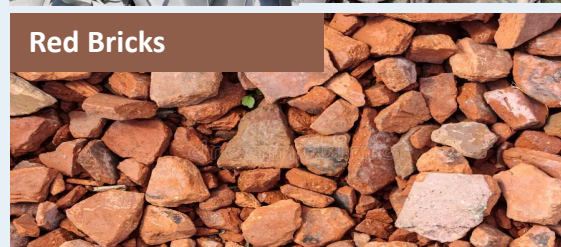
Ceramic & Porcelain



Glass Waste



Red Bricks

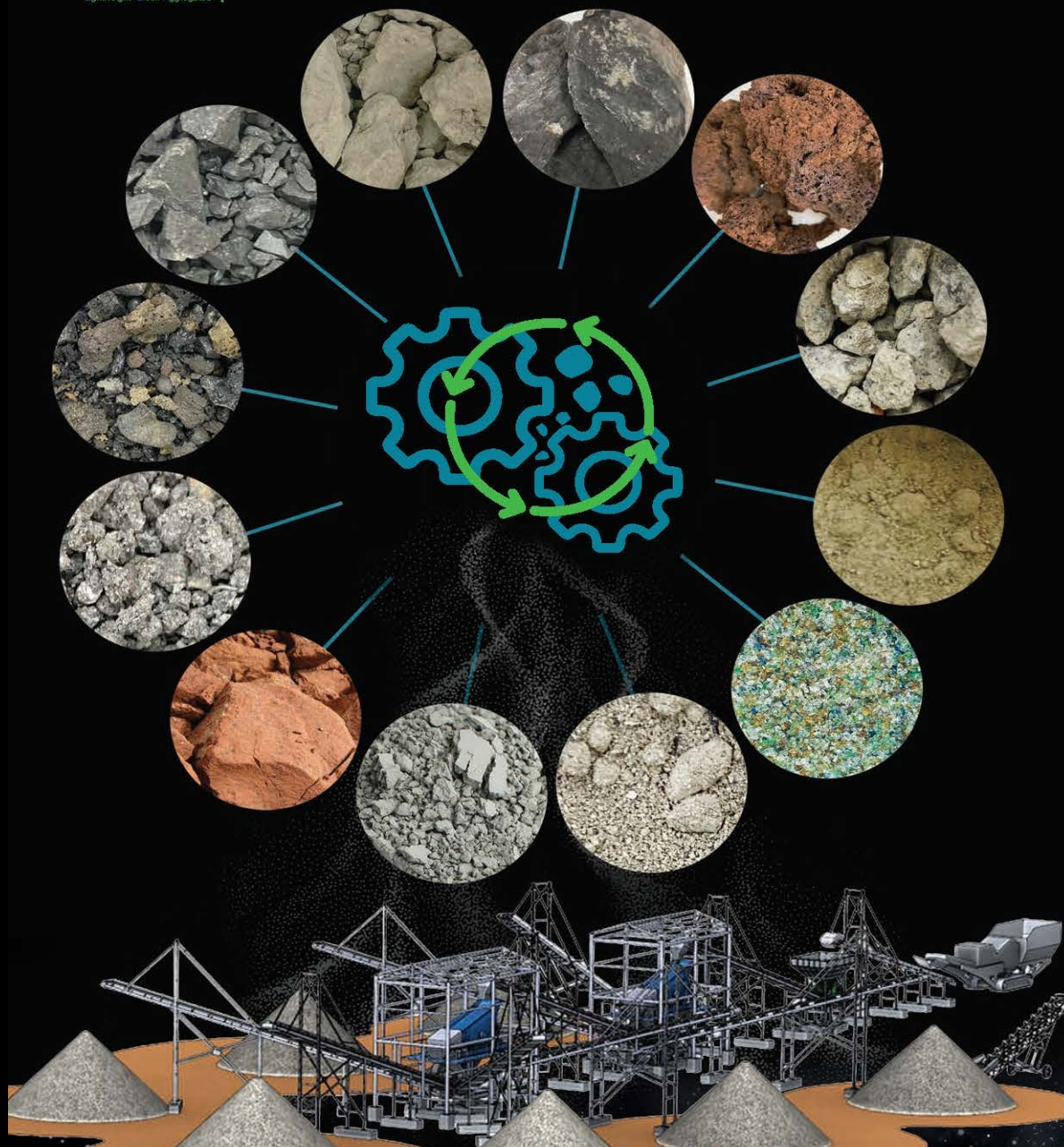


Roof Tiles



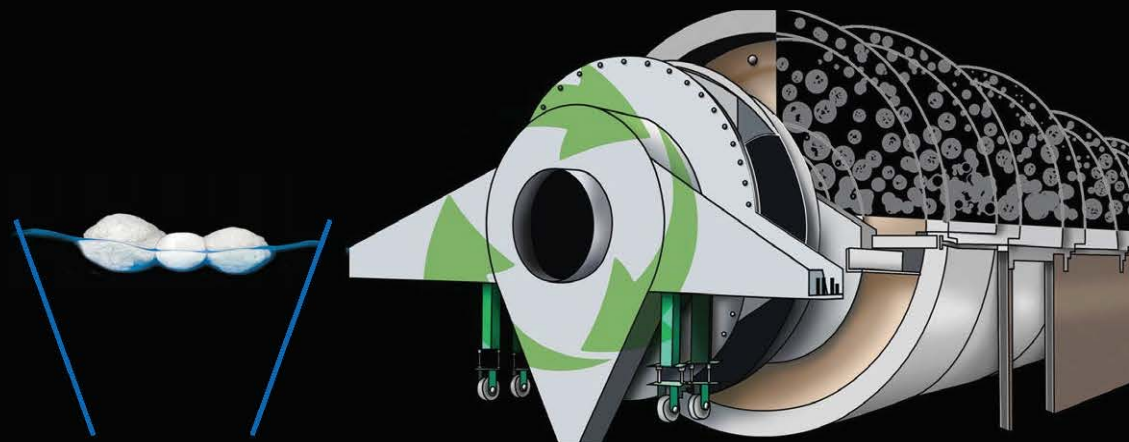
Limbah Konsumen dan Industri

- ✓ Mengubah bahan sampah anorganik menjadi Agregat Ringan Ramah Lingkungan (LiGrA) struktural dan non-struktural baru
- ✓ Solusi Pengelolaan Limbah dan daur ulang menjadi material baru
- ✓ Teknologi canggih untuk merangkum logam berat dan toksisitas untuk bangunan ramah lingkungan dan penggunaan yang aman bagi umat manusia



Teknik Rekayasa Agregat Ringan Ramah Lingkungan

Kami telah bekerja sama dengan produsen inovatif yang berkaliber untuk menciptakan perangkat yang berteknologi tinggi dan hemat energi dengan tingkat emisi karbon yang rendah. Menggunakan peralatan berteknologi mutakhir untuk mengubah berbagai macam limbah menjadi Agregat Ringan Ramah Lingkungan untuk dapat dipergunakan di pelbagai industri.



Pusat R&D Kami

- Agregat ringan menggunakan berbagai bahan limbah
- Desain dan kinerja campuran beton ringan
- Bahan pereduksi air – untuk semen dan denda tambang
- Super penyerap - alami dan sintetis
- Lapisan 3 in 1 – skim, lapisan dasar cat, dan waterproofing
- Lapisan Waterproofing
- Komposit plastik kayu
- Komposit LWA kayu



THE STRAITS TIMES | SATURDAY, SEPTEMBER 10, 2022



Joe Green's Lightweight Green Aggregates (LiGrA) building materials (above) are made from recycled waste. PHOTO: JOE GREEN

Smarter recycling, greener concrete

Joe Green

Concrete is the most widely used commodity in the world and supports the growth of cities through housing and infrastructure.

But it is bad for the built environment. According to German news agency Deutsche Welle, the manufacturing of more than four billion tonnes of cement is responsible for about 8 per cent of global carbon dioxide emissions – more than double the numbers notched up by global flying or shipping.

But what if there were greener ways to make concrete? That was the mission of Mr Boediman Widjaja, chairman and founder of Joe Green, a global group based in Singapore which manufactures innovative building materials for the precast wall business, the built environment and industrial applications.

One of its top-selling ranges is the Lightweight Green Aggregates (LiGrA) line of building materials such as panels and precast concrete. It is made from recycling waste materials such as ceramics, ash, sludge and glass – which, according to the latest report by Singapore's National Environment Agency, form only between 8 and 13 per cent of all waste recycled.

Research and development for

the manufacture of LiGrA started in 2015, with Joe Green staff collaborating with industrial and academic experts from countries including Japan, China, Russia and in Europe. The final product was ready in 2020. Joe Green now produces about 60,000 cubic metres per annum of LiGrA in the form of lightweight concrete aggregates.

The company displayed lightweight wall panels and structural and non-structural LiGrA products at BEX Asia.

Mr Widjaja, 60, graduated with a master's degree in business administration in 1989 from the Florida Institute of Technology in the United States, and has more than 20 years of experience in distribution and trading in South-east Asia, Europe and the US.

"The building materials available in the market today are manufactured from precious natural minerals such as clay, gravel, sand and shale, and imported from overseas. In producing LiGrA from waste, we not only solve the waste disposal problem, but also reduce the exploitation of natural minerals such as granite and sand," he says, adding that Singapore is one of the biggest importers of such natural resources to cater to the demands of the built environment.

Wednesday, December 07, 2022

THE STRAITS TIMES



Our economy is currently based on a linear production and consumption model in which resource wastefulness is inherent.

A major portion of goods post-consumption ends up in landfills or are incinerated which leads to significant economic losses. Also, this leads to over exploitation of the environment thereby posing a threat to the planetary boundaries.

The solution lies in moving to a circular economy. It will lead to a reduction in waste generation and also reuse the generated waste. Thus, reducing the environmental pressure through the reduction in the rate of extraction of raw materials. This also offers benefits in terms of value retention in otherwise waste or under-utilized materials.

JOE Green had foreseen the need for sustainable and circular economy under the 3R Green Concept since its inception 2006 into Precast Hollow core Wall Panel Business. Reduce, Reuse, Recycle.

Our products with hollow core profiles had help reduces: Raw material content by more than 30%, coupled with usage of blasted furnace slag further reduced more than 20% reliance of OPC usage, 50% content of mineral end tail waste from granite quarry – manufactured sand in replacement to concrete sand extracted from natural resources.

Recovery of other industrial waste & transforming to New Lightweight Green Aggregate- LiGrA.

These contributes to lighten up building dead loads, lower carbon footprint. Savings in foundation design, Cost & time with higher productivity and performances.

Since 2015, with more focus on Green Effort and continue its vision to be a Green Builder and Zero Waste Manufacturer. Our journey begins with R&D into carbon neutralizing projects, searching for ultimate solution to manufacture light-weight green aggregate from waste and create a sustainable circular economic built environment.

With successful R&D results, JOE Green commences its venture into setting up an innovative plant to recycle waste into new materials as Light weight Green Aggregate – LiGrA for various industries applications.

Having its new Manufacturing Plant commissioning in Q3 2022 under operation of Gramata Fordea, JOE Green's Green Effort would lead the group of companies into the New Era of achieving its ESG policies and Sustainable Development Goals.



JOE GREEN MARKETING PTE LTD

THE ART OF LIGHTWEIGHT TECHNOLOGY

JOE Green is especially honoured and privileged to have the opportunity to be named once again as one of the top 50 SMEs in the 2022 - E50 Awards. We are grateful and blessed to be able to receive such a prestigious award, we are humbled.



We hope to take this opportunity and spotlight to be able to create a positive difference for the building, construction, and material for a greener and brighter future. In addition, we wish to have this prestige award, we could attract more customers and stakeholders to join our Green projects to save our Just One Earth.

businesstimes.com.sg/singapore/smes/joe-green-makes-concrete-go-green?session-refresh=1

THE BUSINESS TIMES

ENTERPRISE 50

Published Thu, Mar 02, 2023

Joey Kang, Ng Yan Bin, Phua Wei Lin

Joe Green makes concrete go green

WHAT do the upcoming public flats in Tengah estate have in common with Changi Airport's Jewel? The answer may not be immediately visible, but it is central to both developments: their eco-friendly precast concrete walls, supplied by Joe Green Marketing.

The company is a registered Housing and Development Board supplier, and its precast panels are used in over a thousand residential, industrial and commercial buildings in Singapore. Besides being physically lightweight, Joe Green's hollow-core concrete panels are light in terms of environmental impact, as they are made from recycled materials.



Joe Green Marketing's founder and managing director Boediman Widjaja (right) and marketing director Charlina Lim at the Enterprise 50 Awards in 2021.
PHOTO: JOE GREEN MARKETING

THE BUSINESS TIMES

Wednesday, May 03, 2023

Moving light, but with strength: Joe Green sees potential in hi-tech recycled building materials

With new Ligra product, founder Boediman Widjaja seeks to set an eco-friendly example for the industrial waste and construction sector.

BY CHLOE LIM

BUILDING materials manufacturer Joe Green is committed to a zero-waste manufacturing process. Its concrete panels are made of recycled materials, and waste or residual material from the manufacturing process is also reused.

The result of this process is a panel that is both sustainable and lightweight, allowing Joe Green's end customers to build green buildings at lower costs both financial and environmental.

But Joe Green, which was founded in 2006 by Boediman Widjaja, is now facing competition from other building materials companies that are also keen to offer lightweight products. One example is autoclaved aerated concrete walls, which contain air pockets to make them lighter.

So, what will continue to set Joe Green apart? Widjaja, who is both chairman and managing director, is looking to the company's lightweight green aggregate (Ligra) product – the fruit of several years of research and development.

Enter Ligra

Joe Green's Ligra development dates as far back as 2015, as the company considered ways to stay ahead of the competition. "We knew that we had to further improve our own product to truly stand out in the market in the long run, because just being lightweight (at some point) was not enough," said Desmond Ng, technical director at Joe Green.

More than just lightweight and environmentally friendly, Ligra boasts strength and durability. These two factors tend to be compromised in lightweight materials, said Widjaja.

"Lightweight products in the market these days tend to end up very porous, which could compromise the final solid nature of the panel eventually," he said.

Water could end up seeping into wall panels more easily, and create a more drying texture in the long run.

Widjaja said Joe Green's Ligra panels prioritise density and firmness without compromising on the lightweight element.

In its development, Joe Green faced the challenge of sourcing raw materials. "To produce lightweight aggregates, one would need to import them, said Ng.

"We needed to find the best and nearest source (of such material) and ensure that these supply chains were stable."

This turned out to be difficult. "Most neighbouring countries, such as Malaysia and Indonesia, are not (consistently) working on lightweight aggregates," Ng said.

The company could have been sourced for these materials in further markets, such as China, India or Thailand. "But the high costs of imports did not make sense for us," he added.

In addition, many of these lightweight aggregates did not

meet Joe Green's standards, as they did not come from natural sources. So, in 2017, Joe Green started its own inventory of aggregates instead.

These materials have been or are being used in various projects: residential ones such as the up-and-coming Tengah estate, healthcare buildings from National University Hospital to Sengkang General Hospital, and local universities such as the National University of Singapore (NUS), Nanyang Technological University and Yale-NUS College.

"As Ligra continues to be lightweight, transport of the material continues to be cheaper, which saves on overall costs as well," Ng said.

"With buildings made from Ligra, the dead load of the entire building will be 30 per cent lighter, which means now reinforcements can be lighter as well."

Construction processes are also sped up, and hence more efficient, he added. "Furthermore, in that process, a lower dead load due to less concrete (mass) used brings down the carbon footprint as well."

Joe Green has begun mass producing Ligra at its factory in Johor, as the company prepares to promote Ligra with market partners this year. Said Widjaja: "Within this year, we are expecting to see a good response to the product."

A key R&D focus

The "continuous investment" in

research and development (R&D) that has made Joe Green's Ligra product possible has been a core component of the company's activities, said Ng.

"While Ligra has been a main focus in our R&D work, we also spend time and effort improving the systems and operations behind our products," he said. This may take the form of improving existing precasting structures and making lighter 3D-printed products.

"It's always good to sell the standard panel; but in the past, we've received feedback that we were not serving enough customisation needs," Ng said. "So, from 2015, we've been working on more custom options of our panels, to offer various sizes and material types."

With Ligra, wall panels can be made solid or hollow, for example, in the event that wires need to be inserted within the wall. Ng said customised offerings have minimised risks in the construction process and reduced wastage by 5 per cent.

With potential enhanced margins from Ligra, the team at Joe Green is hopeful that more resources can be allocated for R&D.

A 'revolution' for the concrete industry

Ng is looking forward to continuing Joe Green's development of Ligra.

"There will be different models," he said. "Ligra is made from waste glass. We hope to treat bottom ash to make Ligra in the future."



JOE Green's Lightweight Green Aggregates (Ligra) (below) building materials are made from recycled waste. The company has started mass-producing Ligra at its factory in Johor (above), as it prepares to promote the product with market partners this year. PHOTOS: JOE GREEN



It may take some time for Joe Green's product to win over customers, though. "Added costs must be justifiable," Ng said. "But we are sure that market recognition will come quickly for us."

A recent report by French multinational Schneider Electric and the Singapore Green Building Council said 61 per cent of business leaders cited cost and return on investment as their biggest concerns when it comes to green building adoption.

At the same time, an overwhelming 95 per cent of respondents agreed that 80 per cent of Singapore's buildings should be "green" by 2030.

The report surveyed more than 500 business leaders across 340 multinational corporations and

160 small and medium-sized enterprises (SMEs) in Singapore. Such demand presents fertile ground for startups and SMEs keen to enter the green space. Shannon Lung, head of The FinLab, an innovation accelerator by UOB, said: "Sustainability is the path to the future."

The FinLab supports green-tech companies through The Greentech Accelerator.

Last year's inaugural edition accepted 12 SMEs and green-tech startups, and offered funding of up to S\$150,000 for pilot programmes to commercially deploy solutions.

Meanwhile, Joe Green has ambitious expansion plans for the South-east Asian region. In addition to bases in Singapore

Benefits of lightweight green concrete and aggregates

LIGHTWEIGHT GREEN CONCRETE

- Saving in construction cost and time
- Saving in handling and transportation cost
- Saving in foundation cost
- More durable structures
- Higher earthquake resistance
- Longer building service life
- Bigger space savings between columns
- Lintel & stiffener joint cost savings
- Lower crane capacity
- Energy savings benefits
- Sustainable environments built

LIGHTWEIGHT GREEN AGGREGATES

- Extra lightweight and strong
- 100% biodegradable and recyclable
- Environmentally friendly
- Lower carbon footprint
- Economic and competitive
- No hazards to health
- Non combustible
- High resistance to fire
- Good thermal insulation
- High acoustic insulation
- Low water absorption

Recycled lightweight concrete advantages over normal weight concrete

- Internal and external curing
- Strong interface between aggregate and cement
- Modulus compatibility of aggregate and cement

- Continuous strength gain
- Lifelong durability
- Uniform stress distribution

SOURCE: JOE GREEN
GRAPHIC: BT VISUAL

and Malaysia, the company has a plant in Jakarta, Indonesia.

It plans to target every major city in Indonesia.

"Considering Indonesia's sizeable population of over 250 million people, we hope to better tap the market by building a plant in each of Indonesia's major cities, in a bid to move beyond Singapore's market, which is comparatively much smaller," said Widjaja.

He is also entertaining the possibility of going global, having had recent conversations with potential partners in China and Dubai.

"However, it's not easy to get good commercial terms on these fronts (as yet); so this continues to be a work in progress," he added.

"I daresay that Ligra is set to revolutionise the concrete industry," Widjaja said.

"As we move light but strong with this new technology, we are on track to setting an example of strength for the industrial waste and construction sector while emphasising environmental responsibilities."

chloe.lj@sph.com.sg

This is the first of a 5-part Green Business series, in collaboration with UOB, exploring sustainability trends across businesses and industries.

Brought to you by:



Kamis, 11 Mei, 2023

Di bidang komersial, pembangunan berkelanjutan tidak hanya merupakan faktor kunci yang mempengaruhi kelangsungan hidup jangka panjang dan pengembangan perusahaan, tetapi juga tanggung jawab perusahaan kepada masyarakat. Seri "Operasi Berkelanjutan untuk Masa Depan" mewawancarai perusahaan di berbagai bidang yang mengembangkan bahan berkelanjutan atau mengadopsi praktik bisnis berkelanjutan untuk mempelajari bagaimana mereka mengatasi tantangan dan memanfaatkan peluang untuk pembangunan berkelanjutan, mengambil manfaat darinya sekarang dan di masa depan, dan memberi manfaat bagi masyarakat.

Mengembangkan agregat ringan dengan teknologi perlindungan lingkungan untuk menciptakan bangunan hijau tanpa polusi

“

Pada enam tahun pertama, kami mendapat kerugian besar terus menerus. Keluarga saya dan teman-teman pun menyerahkan saya untuk menyerah, tapi Saya tidak mundur sama sekali.

”

■ Lu Lishan

Keyakinan kuat seorang pengusaha untuk memimpin perusahaan produsen lokal tanpa limbah melawan segala rintangan dalam perjalanannya menuju pembangunan berkelanjutan dan penghijauan area dan industri konstruksi global.

Pada tahun 2006, Presiden Huang Zhongren (61 tahun) mendaftarkan JOE Green di Singapura dan mendirikan pabrik. Saat itu, industri konstruksi lokal mulai beralih menggunakan panel dinding semen prefabrikasi. Biro Konstruksi juga mendorong perusahaan konstruksi untuk mengurangi atau mengganti tenaga kerja tradisional dan memakan waktu, batu bata merah berpolusi tinggi yang memerlukan pembakaran kiln.

Dengan sedikit pesaing, dia melihat peluang bisnis dan mendirikan pabrik lokal untuk memproduksi panel dinding semen prefabrikasi. Saat ini, perusahaan merupakan salah satu pemasok panel dinding semen prefabrikasi terbesar di wilayah setempat. Panel dinding semen berongga yang dikembangkan digunakan dalam proyek konstruksi regional dan lokal.

Ini telah menyelesaikan lebih dari 1.000 proyek industri dan komersial, tempat tinggal pribadi, flat HDB pemerintah dan proyek konstruksi kereta bawah tanah secara lokal, termasuk Jewel Changi, serta banyak rumah sakit seperti Pusat Kanker Nasional Singapura dan Rumah Sakit Umum Sengkang. Pada 2013, memasuki pembangunan rusun HDB Pemerintah.

Namun, upaya Huang Zhongren tidak terbatas pada ini. Dia menggunakan limbah daur ulang berteknologi tinggi untuk menghasilkan panel dinding semen prefabrikasi hijau. Kemudian, dia berhasil mengembangkan dan memproduksi bahan baku panel dinding semen ini - agregat ringan hijau (LiGrA, Lightweight Green Aggregates), untuk menyediakan bahan baku alternatif untuk industri konstruksi yang lebih luas. Namun, ada banyak kendala di sepanjang jalan.

Pertama-tama, Huang Zhongren yang lahir di Indonesia adalah seorang agen komputer yang sukses di Indonesia dan daerah setempat pada paruh pertama hidupnya, mengubah karirnya di usia paruh baya dan memasuki bidang teknik penghijauan di industri konstruksi Setelah itu, ia mulai belajar dari awal.

Perusahaan awalnya menyewa bangunan pabrik di kawasan Tuas. Tak disangka, pada 2007, Indonesia mengumumkan embargo bahan baku produksi panel dinding semen: pasir dan batu. Hal ini membuat Huang Zhongren bertekad untuk mempercepat penelitian dan pengembangan daur ulang limbah sebagai bahan baku produksi

.Dia mengenang: "Dalam enam tahun pertama, kami menderita kerugian besar terus menerus. Keluarga dan teman saya bahkan meminta saya untuk menyerah, tetapi saya tidak mundur sama sekali.

Untuk menghemat biaya, kami memindahkan pabrik ke Malaysia pada tahun 2011. Pabrik berlokasi di Senai, Johor, dengan investasi sebesar SGD 9 juta untuk membangun pabrik seluas 3,5 hektar, dan tambahan peralatan penghancur untuk menghancurkan dan mengolah limbah industri seperti ubin dan panel dinding.

Menghasilkan bahan baku hijau dengan teknologi ringan

Tahun ini, mereka berhasil mengembangkan Agregat Beton Daur Ulang, menjadi salah satu produsen tanpa limbah, dan menggunakannya untuk memproduksi panel dinding semen berongga prefabrikasi. Hasilnya, mereka menjadi perusahaan pertama yang dianugerahi empat centang oleh Singapore Green Building salah satu dari beberapa pencetak skor tinggi.

Nama perusahaan, JOE (Hanya Satu Bumi), sesuai dengan misi hijau: Kita hanya memiliki satu Bumi. Huang Zhongren berkata: "Kita harus melindungi bumi dan memperlambat dampak dan penipisan lingkungan, terutama di industri konstruksi."

Industri konstruksi memiliki salah satu jejak karbon tertinggi, menyumbang 40 persen emisi karbon global dan sepertiga dari produksi bahan bangunan seperti baja, semen, dan kaca. Beton yang digunakan dalam konstruksi juga membutuhkan bahan baku lain, seperti pasir atau granit, yang perlu diangkut jauh selama proses penambangan, memperdalam jejak karbon.

Semen adalah zat yang paling banyak digunakan di bumi, tetapi industri semen bertanggung jawab atas sekitar 8% pemanasan global dan emisi karbon dioksida - jauh lebih banyak daripada emisi karbon industri penerbangan global.

Ketika JOE Green mendesain dan memproduksi panel dinding semen berongga prefabrikasi, JOE Green mengurangi bahan baku yang dibutuhkan sekitar 40%, dan menggunakan lebih dari 30% agregat semen daur ulang yang dihasilkan dari limbah industri.

Selanjutnya, JOE Green berkembang menuju teknologi ringan terbarukan. Mereka mengimpor agregat ringan dari luar negeri untuk menghasilkan papan dinding ringan terbarukan. Pada 2015, mereka mengembangkan penelitian ilmiah mereka sendiri dan menggunakan kaca limbah industri untuk menghasilkan agregat ringan hijau.

Dengan pendanaan yang disediakan oleh UOB, JOE Green telah mampu menggunakan sumber daya untuk mengembangkan program penelitian dan pengembangan yang bertujuan untuk mencapai pertumbuhan bisnis yang berkelanjutan. UOB masih terus menjalin hubungan kerjasama dengan perseroan untuk memenuhi kebutuhan pengembangan bisnisnya.

Pada 2017, Joe Green membeli lahan di dekat pabrik di Malaysia untuk persiapan produksi pabrik kedua. Tanpa diduga, epidemi mengganggu semua kemajuan, dan pabrik baru selesai pada tahun 2022.

Hingga kuartal pertama tahun ini, agregat ringan hijau telah digunakan oleh berbagai industri, seperti industri beton siap pakai, komponen prefabrikasi semen industri, industri kimia, dll. Pengujian produk, menyediakan mereka dengan agregat ringan hijau sebagai bahan baku untuk produksi produk hijau.

Agregat ringan hijau ini selanjutnya akan dibuat menjadi bagian prefabrikasi ringan (panel dinding), yang bobotnya lebih ringan, tahan lama, tahan panas dan tahan gempa, sehingga bangunan dapat memiliki umur yang lebih panjang, menghemat konsumsi daya AC dan keamanan bangunan, kondensasi.

Perusahaan juga dapat membuat komponen prefabrikasi yang lebih besar dan lebih ringan sesuai dengan kebutuhan masing-masing proyek, sangat mengurangi konsumsi bahan bakar transportasi, mengurangi kapasitas derek selama pemasangan, dan mempercepat konstruksi karena komponen yang lebih besar, sangat mengurangi jejak karbon.

Partikel kecil, visi besar

JOE Green saat ini berkembang secara lokal, di Malaysia dan Indonesia, dan saat ini memiliki pabrik di ibukota Jakarta. Perusahaan juga berkembang ke arah regionalisasi dan internasionalisasi, banyak negara seperti Cina, Vietnam, India, Timur Tengah dan negara-negara Afrika telah menyatakan minatnya, dan perusahaan akan menemukan solusi kerjasama yang sesuai, termasuk transfer teknologi atau kerjasama strategis lainnya.

Huang Zhongren menekankan: "Terutama negara-negara yang menghasilkan limbah industri dalam jumlah besar dapat mendirikan pabrik LiGrA; limbah industri ini termasuk abu dasar batubara (slag), limbah bauksit (lumpur merah), kaca atau botol, ubin keramik, dan lempung laut. "



Huang Zhongren, Pendiri dan Direktur JOE Green: Berbisnis tidak boleh hanya sekedar untuk keuntungan, tetapi untuk mengukur kebutuhan sekarang dan masa depan. (spesial Fotografi oleh Tan Shuhui)

Secara lokal, negara kita saat ini hanya mendaur ulang sekitar 15% limbah kaca, dan masih ada 85% limbah yang akan diubah menjadi produk terbarukan yang bermanfaat, jadi ada ruang besar untuk pengembangan. Di bawah perencanaan bangunan hijau yang digalakkan oleh pemerintah, JOE Green terus memperkuat kerjasama dan partisipasi dengan fasilitas daur ulang bahan lokal dan departemen pemerintah seperti Badan Lingkungan Hidup Nasional, serta lingkungan, sosial dan tata kelola (Environmental, Social, Governance).

Kini mereka berharap bisa berhasil mendapatkan izin usaha dari Biro Lingkungan Hidup untuk melaksanakan proyek daur ulang limbah kaca, dan menggunakan teknologi perusahaan untuk melakukan daur ulang limbah kaca.

Menurut Huang Zhongren, menjaga lingkungan adalah tanggung jawab generasi ini. "Berbisnis tidak bisa lagi hanya untuk mencari keuntungan, tetapi untuk mengukur kebutuhan masa kini dan masa depan. Lingkungan yang lebih hijau dan berkelanjutan harus kita tinggalkan untuk generasi selanjutnya.

"Bagaimanapun, kita hanya memiliki satu Bumi."



UOB
本系列由大华银行呈献



Di Seluruh Dunia, Bangunan Menyumbang 40% Konsumsi Energi Global dan 33% Emisi Gas Rumah Kaca



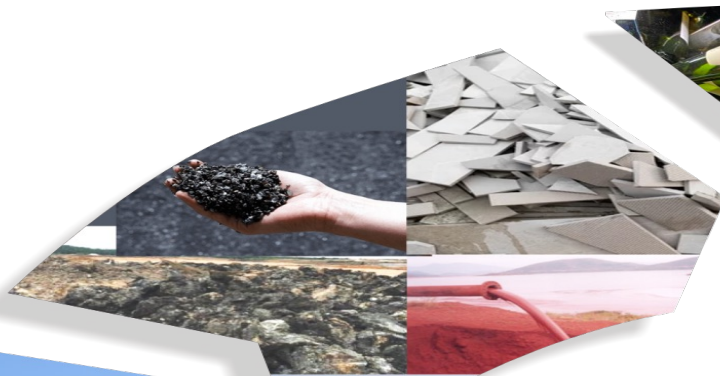
JOE Green memiliki Rencana Dekarbonisasi Industri, Dengan fokus untuk Keberlanjutan



Lightweight Green Aggregates (LiGrA) Terbuat dari Limbah Daur Ulang, Membantu mengurangi Emisi CO2, Penggunaan Sumber Daya dan Biaya Konstruksi.



JOE Green Terus Mengembangkan produk lainnya, dengan tujuan Mengurangi Emisi, Tenaga Kerja, Penggunaan Sumber Daya dan Inefisiensi Energi.



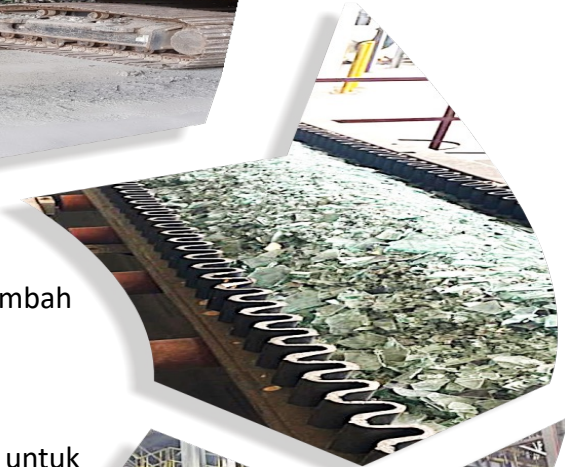
Limbah Industri yang
Dapat Didaur Ulang



Botol Gelas



Penghancuran
Limbah Kaca



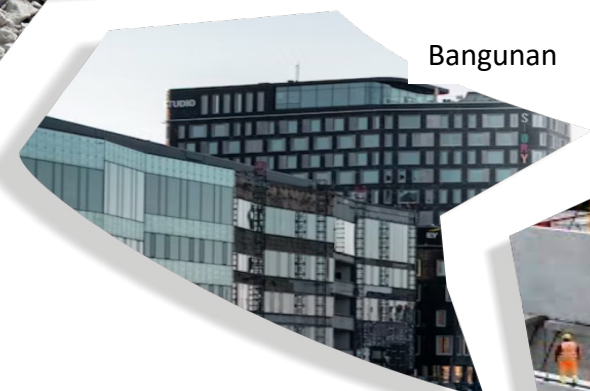
Mengurai Limbah
Kaca



Teknologi Pabrik untuk
Produksi Agregat



Limbah Pembongkaran



Bangunan



Komponen
Pracetak/Ready Mix



Variasi Agregat Ringan
Ramah Lingkungan
(LiGrA)

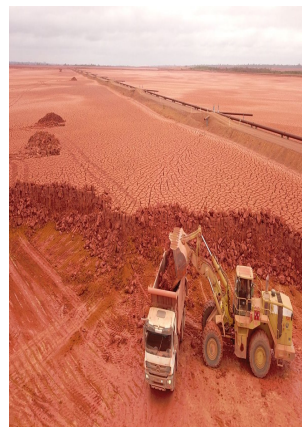
 **Net-Zero**
Mengurangi dampak dari jejak
Emisi / karbon

Sustainability Solution with LiGrA:

Bauxite waste (Red Mud) & Coal Bottom Ash

Raw material

Lightweight Green Aggregates (LiGrA)



Dispose for Landfilled



Lightweight Green Concrete



Chemosphere 307 (2022) 135895



Contents lists available at [ScienceDirect](https://www.sciencedirect.com)

Chemosphere

journal homepage: www.elsevier.com/locate/chemosphere



Recycling municipal solid waste incineration fly ash in super-lightweight aggregates by sintering with clay and using SiC as bloating agent

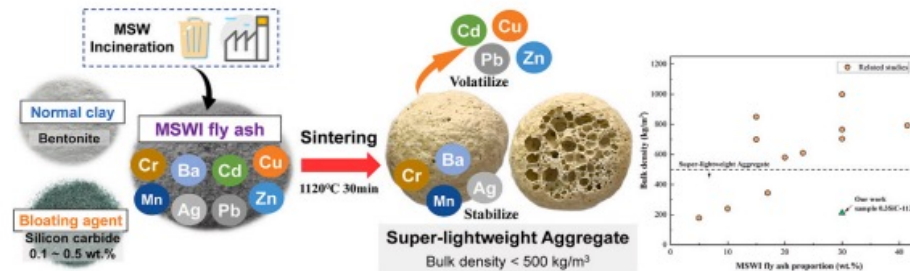
Siyu Han, Yingchun Song, Tongya Mengdan Liu, Jinglin Li, Jianguo

School of Environment, Tsinghua University, Beijing 10008

HIGHLIGHTS

- SiC was applied as bloating agent to produce LWA with MSWI fly ash.
- Super-lightweight aggregate could be produced by adding 0.1–0.5 wt% SiC.
- Effects of SiC addition and sintering conditions were studied in detail.
- Risk of heavy metal leaching toxicity has been mitigated after sintering.
- Formation of complex diopside-based phase during sintering was revealed.

• Risk of heavy metal leaching toxicity has been mitigated after sintering.



Efektivitas Sintering untuk Merangkum Toksisitas Limbah Coal Bottom Ash

Client's Name : JOE GREEN PTE LTD
Sample Ref. : COAL POWER PLANT BOTTOM ASH

Client's Name : JOE GREEN PTE LTD
Sample Ref. : CONCRETE MORTAR WITH 100% COAL POWER PLANT BOTTOM ASH

Client's Name : JOE GREEN PTE LTD
Sample Ref. : BOTTOM ASH - LIGHT WEIGHT AGGREGATE

Test Items	Result ⁽¹⁾	Unit	Test Method	Maximum Allowable Concentration (mg/L) ⁽³⁾	Met Criteria
Arsenic (As)	< 0.1	mg/L	EPA 1311:1992 / EPA 6020B:2014	5	Yes
Barium (Ba)	0.4	mg/L		100	Yes
Cadmium (Cd)	< 0.1	mg/L		1	Yes
Chromium (Cr)	< 0.1	mg/L		5	Yes
Copper (Cu)	< 0.1	mg/L		100	Yes
Iron (Fe)	< 0.1	mg/L		100	Yes
Lead (Pb)	< 0.1	mg/L		5	Yes
Manganese (Mn)	0.1	mg/L		50	Yes
Nickel (Ni)	< 0.1	mg/L		5	Yes
Selenium (Se)	< 0.1	mg/L		1	Yes
Silver (Ag)	< 0.1	mg/L		5	Yes
Zinc (Zn)	0.1	mg/L		100	Yes
Mercury (Hg)	< 0.01	mg/L		0.2	Yes
Phenol Compounds (as Phenol)	< 0.01	mg/L	EPA 1311:1992 / HACH 8047	0.2	Yes
Total Cyanide (as CN ⁻)	< 0.01	mg/L	EPA 1311:1992 / HACH 8027	10	Yes
Fluoride (as F ⁻)	< 0.1	mg/L	EPA 1311:1992 / APHA 4500-F ⁻ C	150	Yes

Remarks:

- (1) < refers to 'less than'.
- (2) Leaching Test - NEA Recommended acceptance criteria for suitability of industrial wastes for landfill disposal.
- (3) The above results were tested as per sample submitted by client.
- (4) Conformity statement reported with no decision rule applied. Uncertainty of measurement available on request.

Test Items	Result ⁽¹⁾	Unit	Test Method	Maximum Allowable Concentration (mg/L) ⁽³⁾	Met Criteria
Arsenic (As)	< 0.1	mg/L	EPA 1311:1992 / EPA 6020B:2014	5	Yes
Barium (Ba)	0.7	mg/L		100	Yes
Cadmium (Cd)	< 0.1	mg/L		1	Yes
Chromium (Cr)	0.1	mg/L		5	Yes
Copper (Cu)	< 0.1	mg/L		100	Yes
Iron (Fe)	< 0.1	mg/L		100	Yes
Lead (Pb)	< 0.1	mg/L		5	Yes
Manganese (Mn)	< 0.1	mg/L		50	Yes
Nickel (Ni)	< 0.1	mg/L		5	Yes
Selenium (Se)	< 0.1	mg/L		1	Yes
Silver (Ag)	< 0.1	mg/L		5	Yes
Zinc (Zn)	0.1	mg/L		100	Yes
Mercury (Hg)	< 0.01	mg/L		0.2	Yes
Phenol Compounds (as Phenol)	< 0.01	mg/L	EPA 1311:1992 / HACH 8047	0.2	Yes
Total Cyanide (as CN ⁻)	0.020	mg/L	EPA 1311:1992 / HACH 8027	10	Yes
Fluoride (as F ⁻)	0.5	mg/L	EPA 1311:1992 / APHA 4500-F ⁻ C	150	Yes

Remarks:

- (1) < refers to 'less than'.
- (2) Leaching Test - NEA Recommended acceptance criteria for suitability of industrial wastes for landfill disposal.
- (3) The above results were tested as per sample submitted by client.
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Barium (Ba)	< 0.1	mg/L		100	Yes
Cadmium (Cd)	< 0.1	mg/L		1	Yes
Chromium (Cr)	< 0.1	mg/L		5	Yes
Copper (Cu)	< 0.1	mg/L		100	Yes
Iron (Fe)	< 0.1	mg/L		100	Yes
Lead (Pb)	< 0.1	mg/L		5	Yes
Manganese (Mn)	< 0.1	mg/L		50	Yes
Nickel (Ni)	< 0.1	mg/L		5	Yes
Selenium (Se)	< 0.1	mg/L		1	Yes
Silver (Ag)	< 0.1	mg/L		5	Yes
Zinc (Zn)	< 0.1	mg/L		100	Yes
Mercury (Hg)	< 0.01	mg/L		0.2	Yes
Phenol Compounds (as Phenol)	< 0.01	mg/L	EPA 1311:1992 / HACH 8047	0.2	Yes
Total Cyanide (as CN ⁻)	< 0.01	mg/L	EPA 1311:1992 / HACH 8027	10	Yes
Fluoride (as F ⁻)	0.1	mg/L	EPA 1311:1992 / APHA 4500-F ⁻ C	150	Yes

Remarks:

- (1) < refers to 'less than'.
- (2) Leaching Test - NEA Recommended acceptance criteria for suitability of industrial wastes for landfill disposal.
- (3) The above results were tested as per sample submitted by client.
- (4) Conformity statement reported with no decision rule applied. Uncertainty of measurement available on request.

FASILITAS OPERASI DAN PRODUKSI YANG KOKOH



FASILITAS PENELITIAN YANG CANGGIH



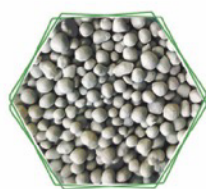
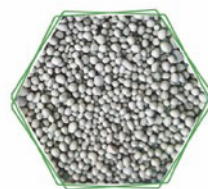
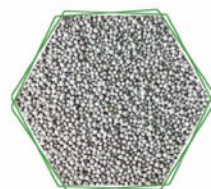
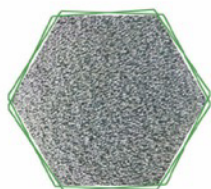
ANNUAL PRODUCTION
60.000 M³



Superior Material
Properties & Performance



Efficient and High Quality
Production Facility



ZERO
WASTE MANUFACTURER

Zero Waste
Manufacturing

Properties	Mikron 0.1	Mikron 0.25	Mikron 0.50	Mikron 1
Grain size [mm] ⁽¹⁾	0.1 – 0.25	0.25 – 0.5	0.5 – 1	1 – 2
Bulk Density in [kg/m³] ⁽²⁾ (± 50)	420	360	290	250
Effective particle density [kg/m³] ⁽³⁾ (± 50)	1050	790	550	450
Bulk crushing resistance [N/mm²] ⁽⁴⁾ (± 10%)	4.7	3.3	3.1	2.6
Softening point [°C]	860/1250			
Melting point [°C]	1250 – 1500			
Thermal Conductivity [W/ (m.k)] ⁽⁵⁾	< 0.07			
Water absorption % by mass (± 20%)	30			
Colour	Light creamy white			
pH value	7 – 12			
Grain form	Sphere			

Note: More than 90% of the Lightweight Aggregates (LWA) falls within the specified size.

1) Technical data given after testing basic grain sizes according to EN 13055 – 1:2016/AC: 2016

2) Manufacturing tolerance

3) According to EN 1097 – 6: 2013

4) According to EN 13055 – 1: 2016

5) According to EN 12939: 2002

The properties shown on this data sheet represent typical average results generated using standard test method, conducted under controlled conditions and cannot be considered to be guaranteed specifications. Properties are subject to normal manufacturing statistical standard deviation ranges and the company reserves the right to modify the properties and specifications at any time without prior notice.

Properties	LD	HD (Low)	HD (High)	Fahrenheit
Grain size [mm] ⁽¹⁾	3-8			
Bulk Density in [kg/m ³] ⁽²⁾ (± 50)	200	600	800	150
Effective particle density [kg/m ³] ⁽³⁾ (± 50)	320	1000	1250	270
Bulk crushing resistance [N/mm ²] ⁽⁴⁾ (± 10%)	1.8	12.5	21	0.6
Softening point [°C]	860			
Melting point [°C]	1250 – 1500			
Thermal Conductivity [W/ (m.k)] ⁽⁵⁾ (± 10%)	0.07	0.12	0.18	0.06
Water absorption % by mass ⁽⁶⁾	< 30	< 8	< 5	< 40
Colour	Off white			
pH value	7 – 12			
Grain form	Sphere			

Note: More than 90% of the Lightweight Aggregates (LWA) falls within the specified size.

1) Technical data given after testing basic grain sizes according to EN 13055 – 1:2016/AC: 2016

2) Manufacturing tolerance

3) According to EN 1097 – 6: 2013

4) According to EN 13055 – 1: 2016

5) According to EN 12939: 2002

6) According to EN 1097 – 6: 2013

The properties shown on this data sheet represent typical average results generated using standard test method, conducted under controlled conditions, and cannot be considered to be guaranteed specifications. Properties are subject to normal manufacturing statistical standard deviation ranges and the company reserves the right to modify the properties and specifications at any time without prior notice.

PENGUNAAN



PPVC & PBU Precast



Lightweight Building Materials



Lightweight Ready-Mix, Concrete & Industrialised Building System (IBS)



Hydroponic Media



Isolasi Termal pada Atap, Lantai dan Pintu Tahan Api



Floating Concrete & Structure



Insulation of Pipeline in Oilfield



Lightweight Fillers for Ceramic and Polymeric Products



Filtration Media



Plester & Semen Instan Tahan Panas



Geotechnical Applications (Retaining Wall, Soil Stability & Foundation)



Wastewater Treatment



Automotive Body Composite



Bahan-Bahan Dekoratif

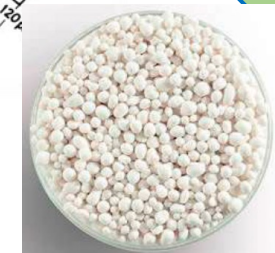
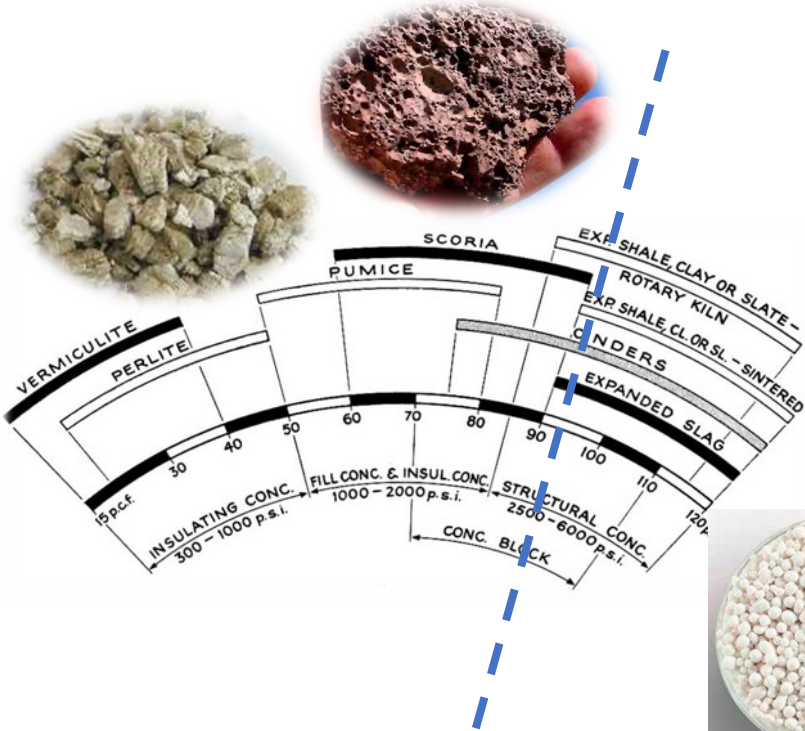


Cat & Wallpaper Tahan Panas

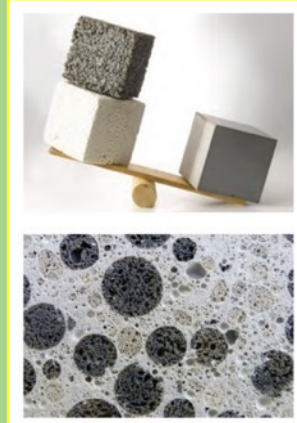
Apa itu Agregat Ringan Ramah Lingkungan?

Agregat ringan (LWA) adalah butiran atau pelet dari bahan ringan yang memiliki banyak aplikasi. Mereka dapat ditambang dari sumber alami atau diproduksi menggunakan mineral atau bahan limbah.

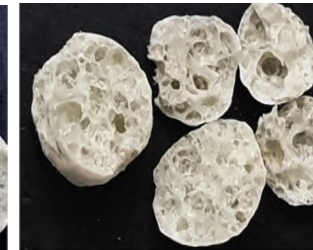
Agregat Ringan Alami



Agregat Ringan yang diproduksi



Structural LiGrA
Densely packed finer pores



Non-Structural LiGrA
Loosely packed coarser pores

Apa itu Beton Ringan Ramah Lingkungan?

Beton Ringan diproduksi dengan mengganti **agregat berat** dengan **agregat ringan**

1m³ dari Beton Berat Normal

Cement	Agregat halus (Pasir)
	Agregat Kasar (Granit)
Air	

Kepadatan = 2400 Kg/m³

1m³ dari Ringan Beton

Cement	Agregat halus (LWA)
	Agregat Kasar (LWA)
Air	



Kepadatan > 800 to 2000 Kg/m³

→ Aplikasi Struktural

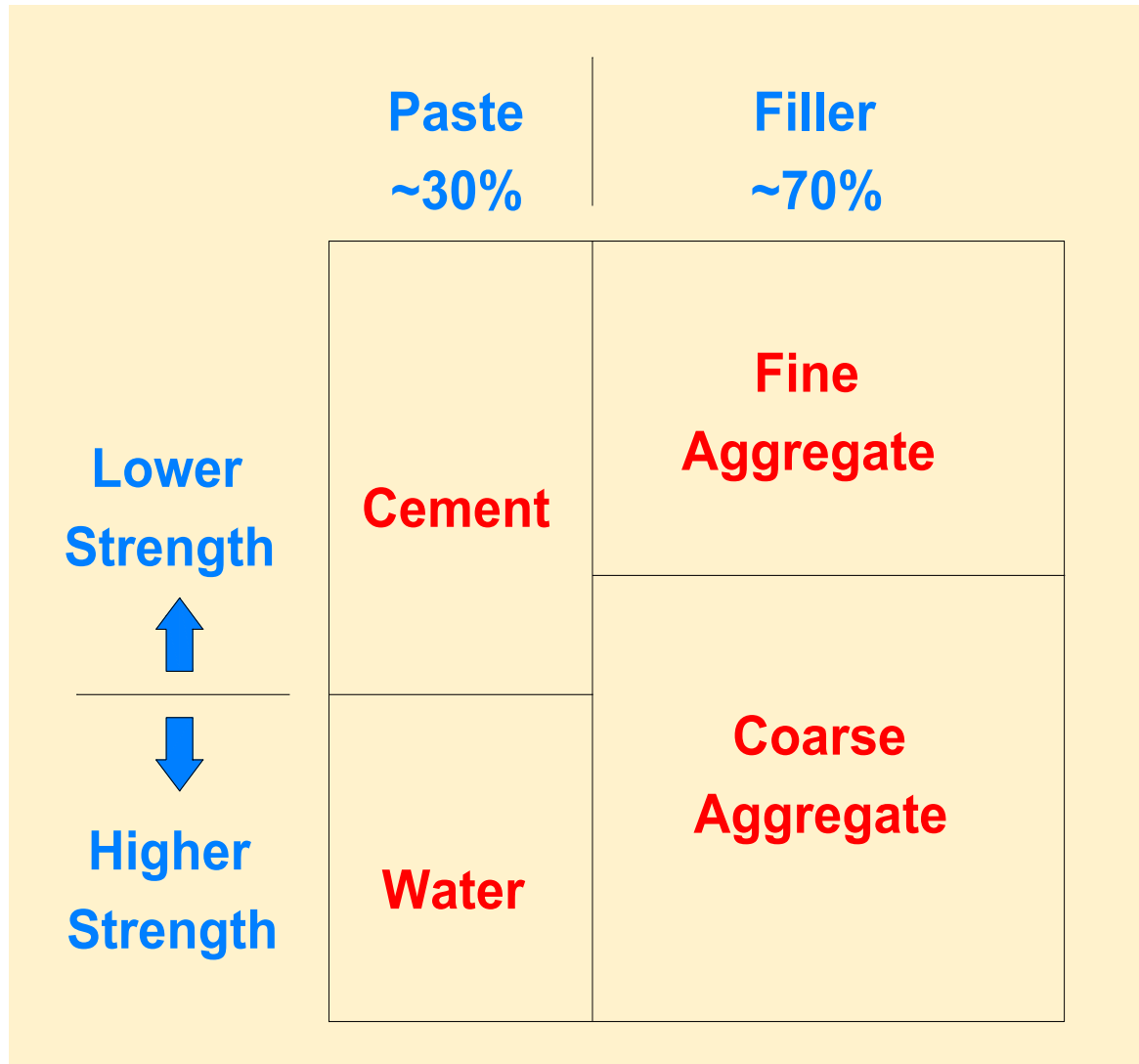
Kepadatan < 800 Kg/m³

→ Aplikasi Non-Struktural

SEJARAH BETON - Tonggak Sejarah

- 1844 ○ Semen Portland
- 1849 ○ Beton Bertulang
- 1917 ○ Beton Agregat Ringan
- 1929 ○ Beton Pratekan
- 1960 ○ Beton Bertulang Serat
- 1980 ○ Polycarboxylate Eter

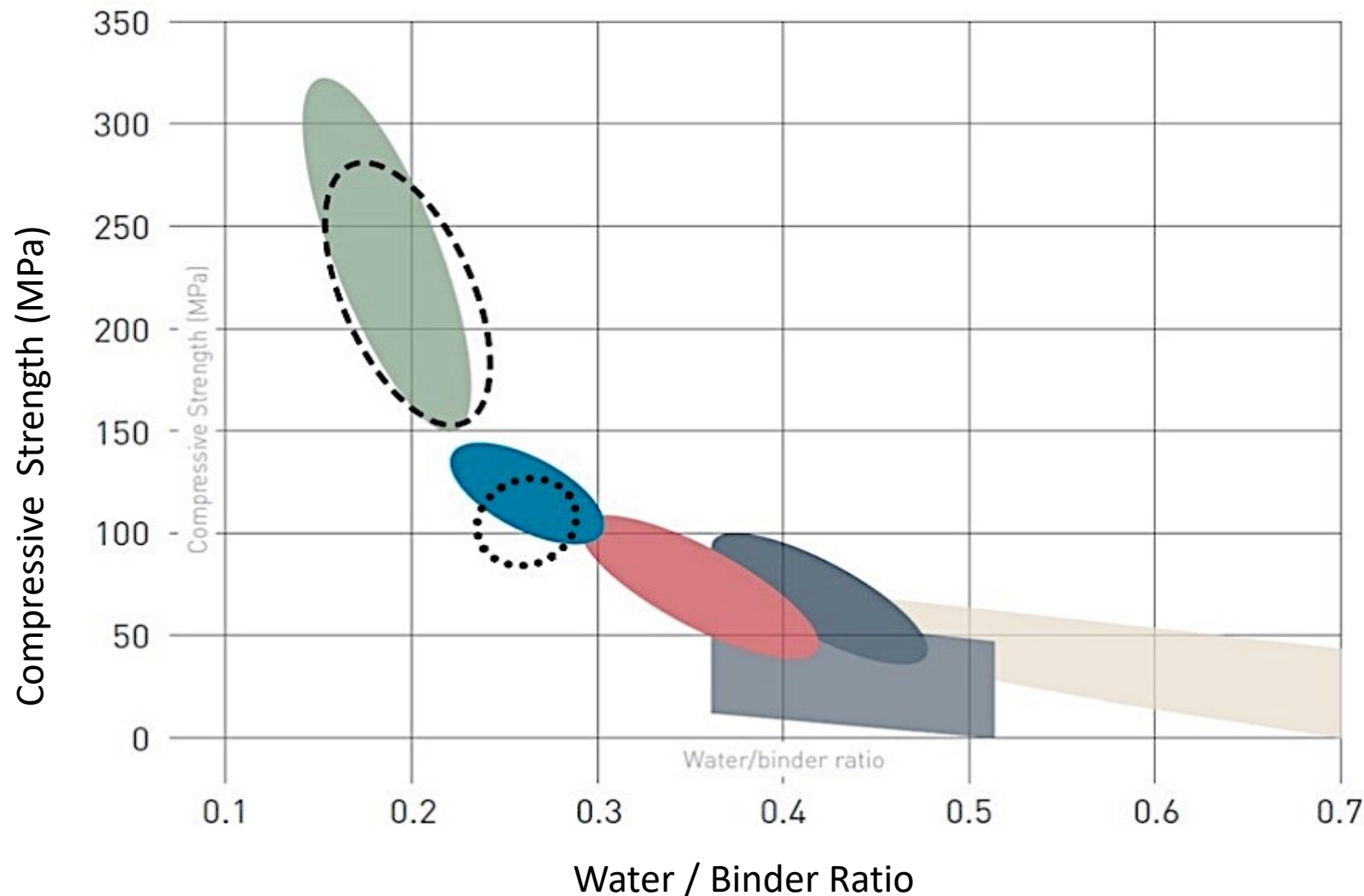
Efek jika Polycarboxylate Ether dalam Beton



Pengurangan air dalam beton meningkatkan kekuatan tetapi mengurangi kemampuan pengerjaan.

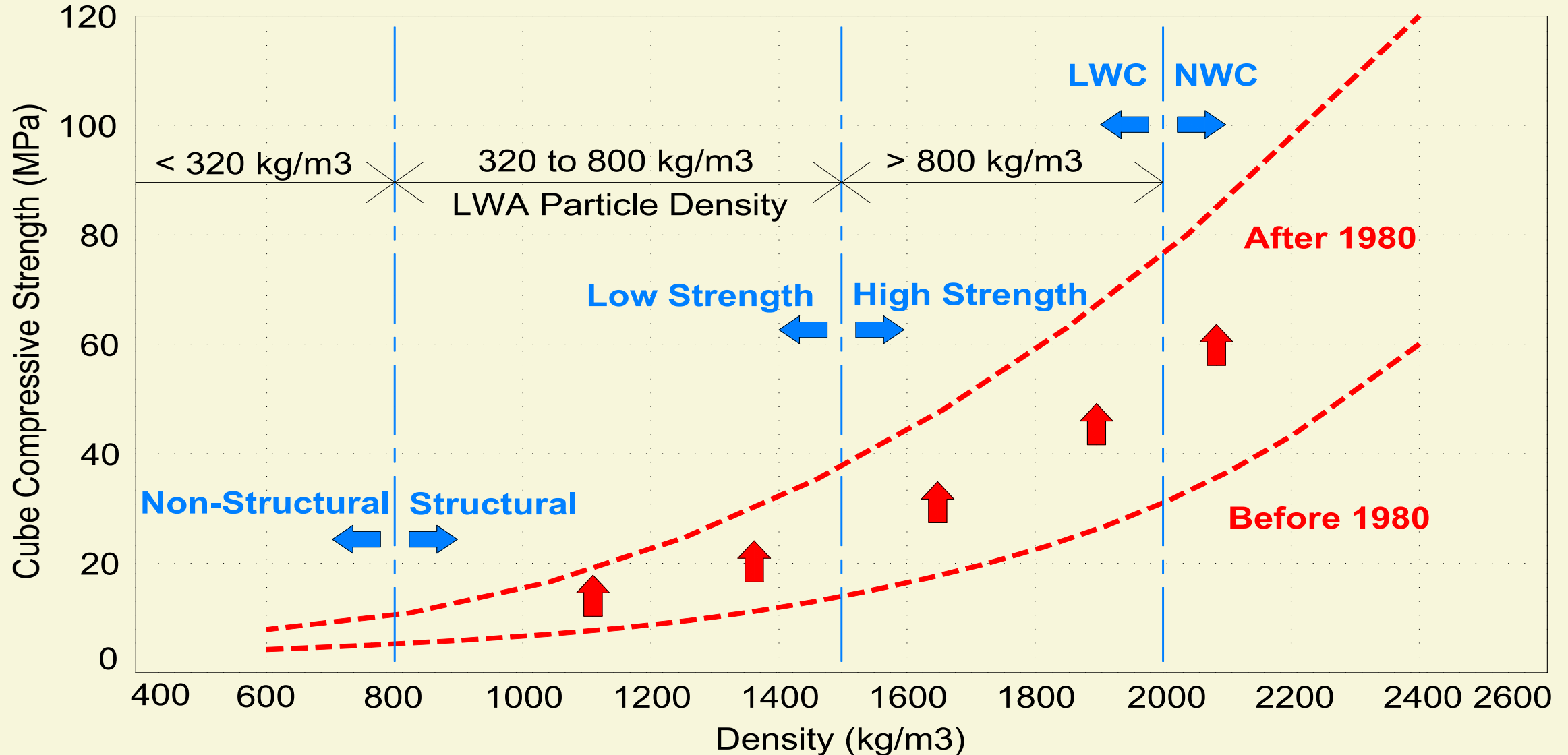
Polycarboxylate Ether membantu mengurangi air dalam beton tanpa mengurangi workability.

Historical Classification of Concrete



**Fokusnya adalah pada kekuatan.
Sekarang arahnya telah
dialihkan ke Kepadatan.**

Kekuatan LWC meningkat setelah tahun 1980



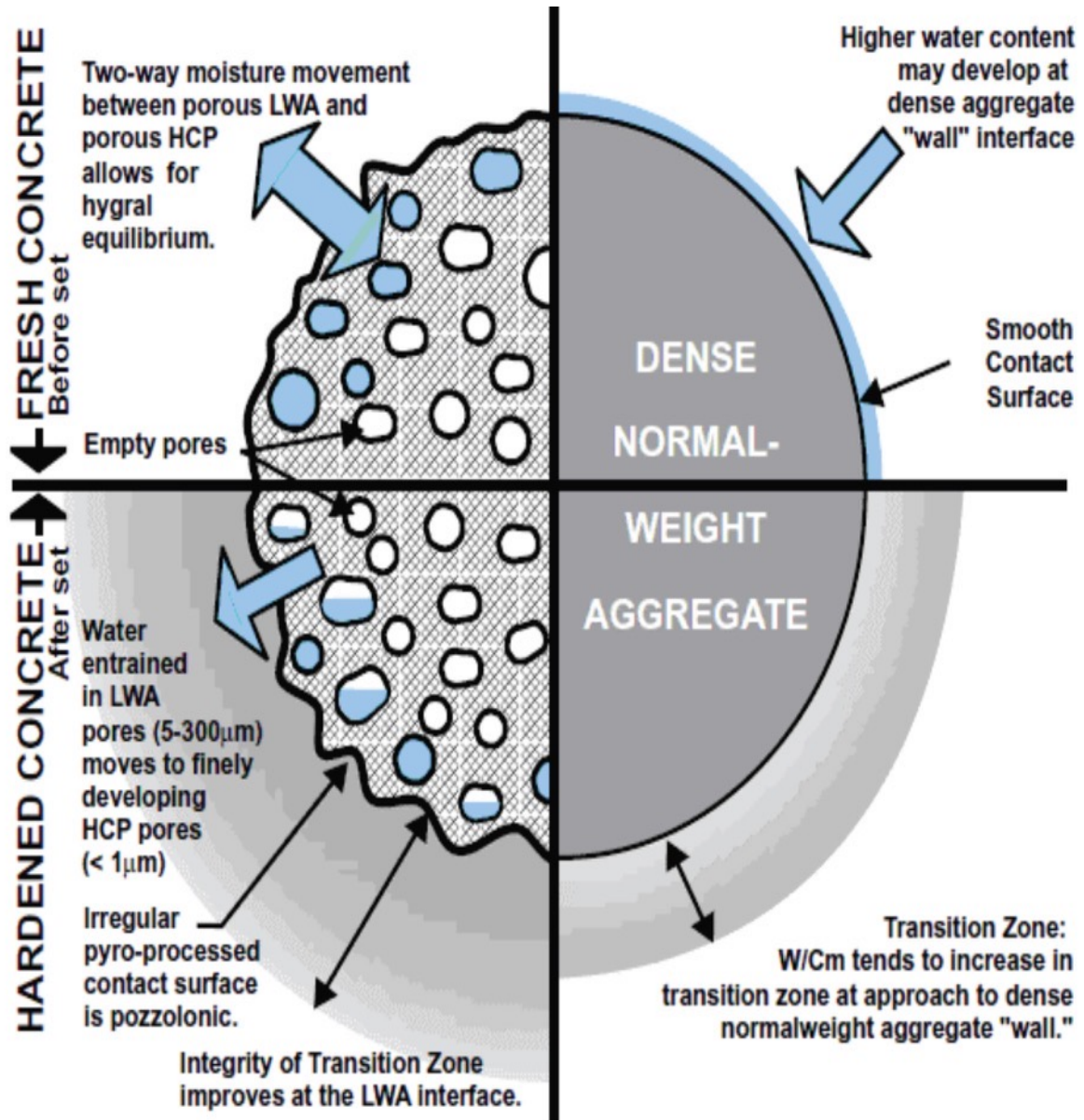


Agregat ringan paling sering digunakan dalam beton agregat ringan. Dibandingkan dengan beton berat normal, beton agregat ringan telah terbukti secara ilmiah menunjukkan **daya tahan yang luar biasa dan kinerja yang lebih tinggi** yang dikaitkan dengan tiga faktor:

1. Penyembuhan Internal Berkepanjangan
2. Agregat yang kuat - pasta semen antarmuka
3. Kompatibilitas modulus agregat dan pasta semen

Diluncurkan pada tahun **1919**, USS SELMA dibangun dengan beton agregat ringan dengan kuat tekan **26,7 MPa**. Pada tahun **1980**, ketika para ilmuwan melakukan uji inti di kapal, kekuatan yang ditemukan meningkat menjadi **55,2 MPa**. Fenomena ini tidak pernah terdengar untuk beton berat normal.

Perawatan Internal dan Antarmuka yang Kuat

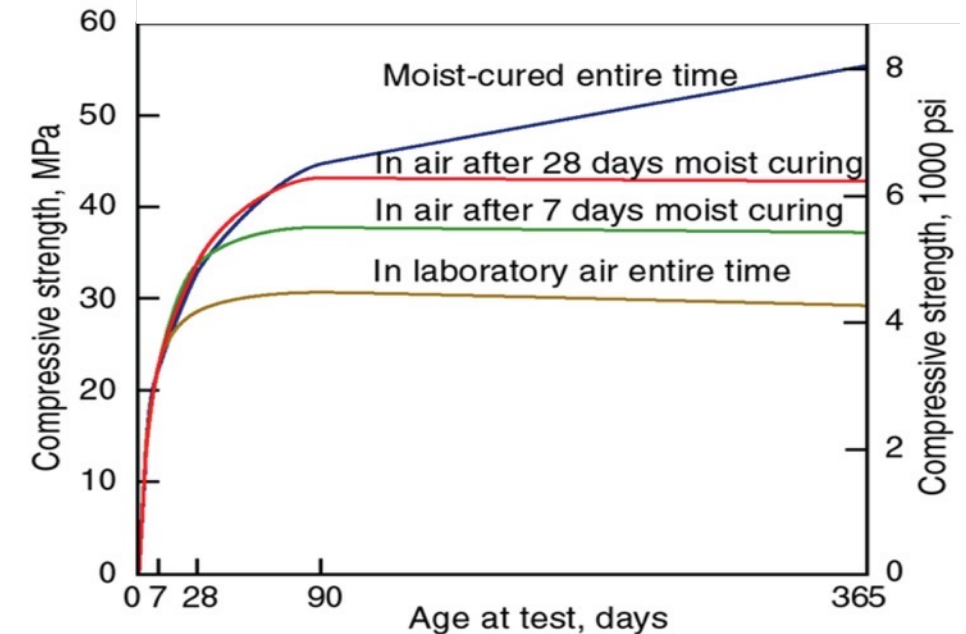
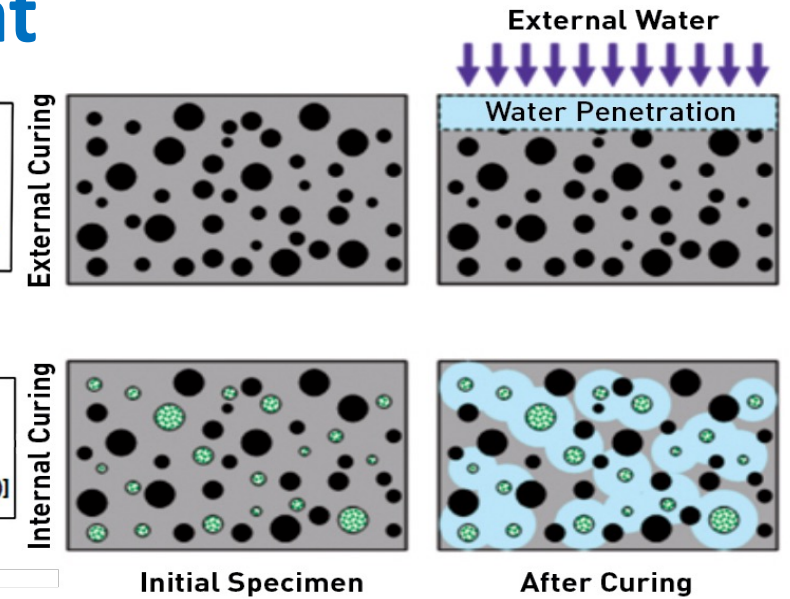


NWA

Interface between Hydrating Cement Paste (HCP) and the non-absorbing dense normalweight aggregate "wall"

LWA

Interface between two porous materials [LWA pores and Hydrating Cementitious Paste (HCP)]



Aplikasi Penggunaan Beton Ringan



The Wellington Stadium
New Zealand's First Use of High Strength Lightweight Precast Concrete

Leonard G. McSaveney
Golden Bay Cement, Division of Fletcher Concrete & Infrastructure, Ltd., Auckland, New Zealand

**STRUCTURAL
ENGINEER**
Holmes Consulting
Group

**LIGHTWEIGHT
PRODUCER**
TXI Pacific Custom
Materials, Inc., CA

CONTRACTOR
Fletcher
Construction Ltd.

PRECAST SUPPLIER
Stresscrete

OWNER
The Wellington Stadium
Development Trust



Exterior of 40,000-seat Wellington Stadium nearing completion



BRITISH STANDARD

Lightweight aggregates —

Part 1: Lightweight aggregates for
concrete, mortar and grout

BS EN
13055-1:2002
*Incorporating
Corrigendum No. 1*

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8 Designation.....	11
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Annex C (normative) Determination of resistance to freezing and thawing of lightweight aggregates	18
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FAKTOR	STATUS	MENDEKATI MASA DEPAN
Logistik	Europe USA Japan	Sampah >>Peningkatan Pemasok LWA Regional
Familiarity	BS EN – 2004 / SS EN – 2008 (Eurocode 2)	
Cost	High shipping cost Use of mined minerals	Regional Supplier – lower transportation cost Use of waste – reduce cost

BS EN 1992 - Faktor Reduksi untuk Beton Ringan		
CONCRETE MECHANICAL PROPERTIES	DENSITY CLASS	
	1.6	1.8
Compressive Strength	1	1
Tensile Strength	0.85	0.9
Shear Strength	0.71	0.75
Secant Modulus	0.56	0.71
Creep Coefficient	0.56	0.71

Mengapa Beton Ringan tidak umum digunakan?

Table 11.1: Density classes and corresponding design densities of LWAC according to EN 206-1

Density class		1,0	1,2	1,4	1,6	1,8	2,0
Density (kg/m ³)		801-1000	1001-1200	1201-1400	1401-1600	1601-1800	1801-2000
Density (kg/m ³)	Plain concrete	1050	1250	1450	1650	1850	2050
	Reinforced concrete	1150	1350	1550	1750	1950	2150

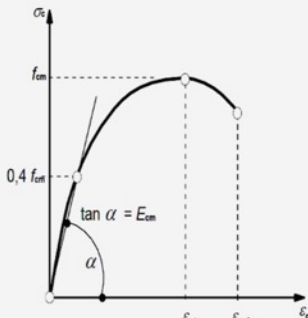
Pengurangan Berat Dari RC

Class 1.6 = 30%

Class 1.8 = 22%

English version	
Eurocode 2: Design of concrete structures - Part 1-1: General rules and rules for buildings	
BS EN 1992-1-1:2004 EN 1992-1-1:2004 (E)	
SECTION 11 LIGHTWEIGHT AGGREGATE CONCRETE STRUCTURES	
11.1 General	
(1)P This section provides additional requirements for lightweight aggregate concrete (LWAC). Reference is made to the other Sections (1 to 10 and 12) of this document and the Annexes.	

Faktor koreksi untuk kekuatan beton

	Normal Weight Concrete	Lightweight Concrete	Remark
Comp Strength	$f_{cd} = \alpha_{cc} f_{ck} / \gamma_c$	$f_{lcd} = \alpha_{lcc} f_{lck} / \gamma_c$	$\alpha_{cc} = \alpha_{lcc} = 0.85$ and $\gamma_c = 1.5$ for both
Tensile Strength	Value given in Eurocode 2, Table 3.1	NWC value multiplied by $\eta_1 = 0.40 + 0.60 \rho_p / 2000$	$\eta_1 = 0.85$ & 0.89 for Class 1.6 & 1.8, respectively
Shear Strength	$v = 0.6 [1 - f_{ck} / 250]$	$v = 0.5 \eta_1 [1 - f_{ck} / 250]$	Shear Capacity Reduction = 0.71 and 0.75 for Class 1.6 & 1.8, respectively
Secant Modulus	Value given in Eurocode 2, Table 3.1	NWC value multiplied by $\eta_E = (\rho / 2200)^2$	$\eta_E = 0.56$ & 0.71 for Class 1.6 & 1.8, respectively
Creep	Value given in Eurocode 2, Table 3.2	NWC value multiplied by Factor = $\eta_2 (\rho / 2200)^2$ where $\eta_2 = 1.3$ for $f_{lck} \leq LC16/18$ $\eta_2 = 1.0$ for $f_{lck} \geq LC20/22$	Considered in water retaining structure where crack control is particularly important.
Shrinkage	Value given in Eurocode 2, Table 3.2	NWC value multiplied by η_3 where $\eta_3 = 1.5$ for $f_{lck} \leq LC16/18$ $\eta_3 = 1.2$ for $f_{lck} \geq LC20/22$	Considered in water retaining structure where crack control is particularly important.
Non-linear Behaviour		ϵ_{c1} and ϵ_{cu1} should be replaced with ϵ_{lc1} and ϵ_{lcu1} given in Table 11.3.1 in Eurocode 2	No impact when using first order elastic analysis
Concrete Protection	Exposure class given in Table 4.1 and concrete cover given in Table 4.2 in Eurocode 2	No change for exposure class. Concrete cover given in Table 4.2 increased by 5mm	Using LWC does not reduce environmental protection.

Pengurangan Emisi Karbon

	BETON DENGAN		
	LiGrA	LWA	NWA
Daya Tahan Lebih Tinggi	EC	EC	X
Bahan Baku Lebih Ringan & Beton	EC	EC	X
Komponen Pracetak yang Lebih Ringan	EC	EC	X
Komponen Pracetak yang Lebih Besar	EC	EC	X
Struktur Rentang Yang Lebih Panjang	X	X	X
Berat Bangunan Lebih Ringan	EC	EC	X
Ketahanan Gempa yang Lebih Baik	X	X	X
Ketahanan Termal Yang Lebih Tinggi	OC	OC	X
Mengganti Sumber Daya Alam	EC	X	X
Mendaur Ulang Sampah	EC	X	X

EC Pengurangan Embodied Carbon Emission
OC. Pengurangan Emisi Karbon Operasional



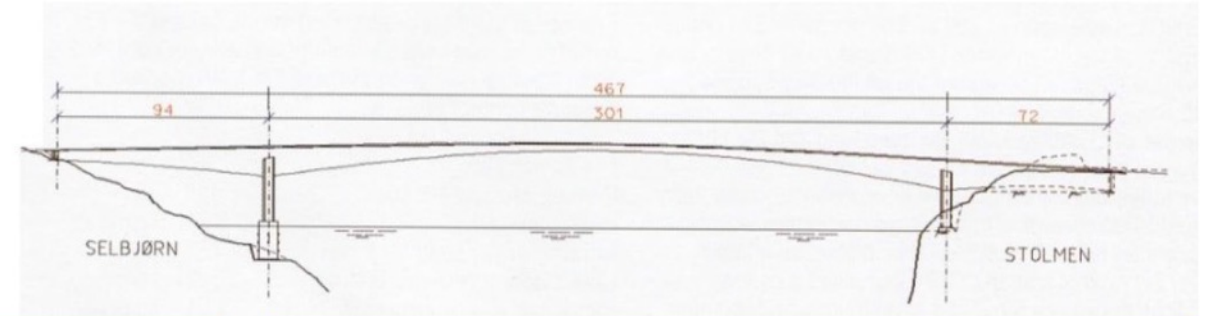
The Bank of America, Charlotte, N.C. built in 1991

Tiang beton ringan - balok tarik dengan sistem lantai dipilih untuk Minimalkan bobot mati dan untuk mencapai peringkat kebakaran 3 jam yang diperlukan.

Mix Design	1	2	3
Cement (kg/m ³)	326	385	445
Fly Ash (kg/m ³)	83	83	83
LWA (kg/m ³)	534	534	534
Sand (kg/m ³)	813	763	714
WRA (l/m ³)	0.78	0.90	1.01
HRWRA (l/m ³)	1.56	2.31	2.27
Fresh Concrete Properties			
Initial Slump (mm)	63	51	57
Slump after HRWRA (mm)	130	191	171
Air Content	2.5	2.5	2.3
Fresh Conc Density (kg/m ³)	1887	1890	1890
Compressive Strength			
4 days	29.6	35.2	39.4
7 days	33.6	39.9	44.4
28 days	43.2	47.0	51.4

The Stolma Bridge, Norway

Dengan menyesuaikan kepadatan pertengahan 301m - bentang dengan Beton ringan, memungkinkan untuk memindahkan pilar ke perairan yang lebih dangkal dan mengurangi biaya untuk Pembangunan



Properties of LWAC		
Mix Design		
Cement CEM-1 52.5	420	kg/m ³
Silica Fume	35	kg/m ³
Natural Sand (dry)	700	kg/m ³
LECA 800 4-12mm	600	kg/m ³
Water	208	kg/m ³
Stabiliser Melstab	12	kg/m ³
Retarder	1	kg/m ³
Leca 800 Dry Bulk Density	825	kg/m ³
Leca 800 Dry Particle Density	1450	kg/m ³
Mean Cube Strength	70.4	MPa
Characteristic Cube Strength	64.1	MPa
Demoulded Density	1931	kg/m ³
Density 28d Cubes	1940	kg/m ³

The Nordhordland Floating and Cable Stayed Bridge in Norway completed in 1993

LWAC kekuatan tinggi digunakan di pontoon dan bentang utama jembatan.

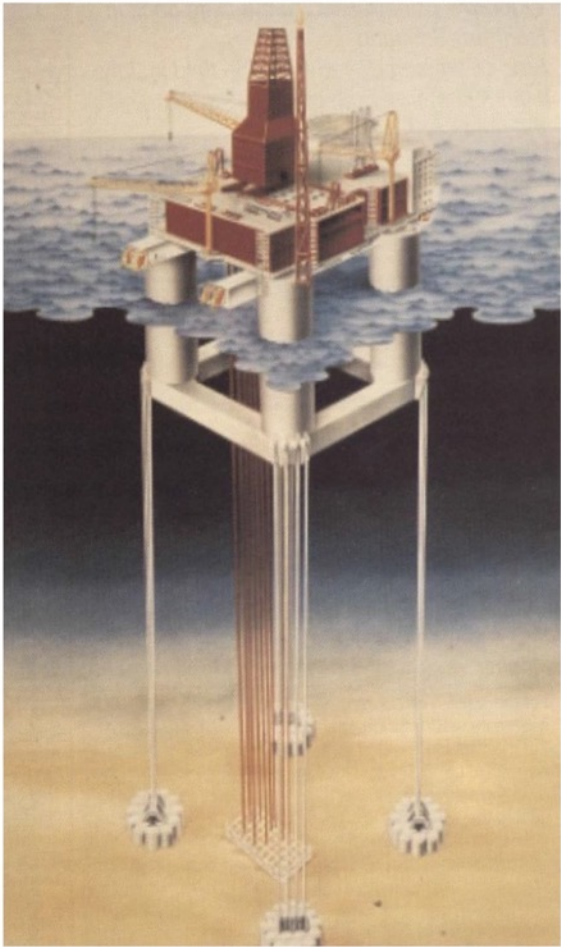


Mix Design for LWAC	LC55 in Pontoon	LC55 in Bridge	
Portland Cement	410	430	kg/m ³
Silica Fumes	33	35	kg/m ³
Sand 0-5 mm	675	630	kg/m ³
Liapor 8, 4-8 mm	270		kg/m ³
Liapor 8, 8-16 mm	325		kg/m ³
LECA 750, 4-8mm		295	kg/m ³
LECA 750, 8-12mm		275	kg/m ³
Water	200	195	kg/m ³
WRA/HRWRA	10 to 12	7	kg/m ³
Demolding Density	1918	1881	kg/m ³
Ave Cube Strength	70.4	69.9	Mpa
Standard Deviation	4.31	2.38	MPa
Bulk Density	800	750	kg/m ³
Particle Density	1440	1300	kg/m ³

Daya apung tinggi yang diperlukan untuk platform kaki tegangan disediakan penggunaan beton ringan kekuatan tinggi.

Mix Design of LWAC		
Cement	420	kg/m3
Silica Fume	20	kg/m3
Sand	720	kg/m3
Liapor 8, 4-8 mm (dry weight)	307	kg/m3
Liapor 8, 8-16 mm (dry weight)	254	kg/m3
Superplasticizer	6 to 9	kg/m3
Air-entraining admixture	1 to 3	kg/m3
Fresh Density	1885	kg/m3
7 Day Strength	70	Mpa
7 Day Standard Deviation	3.0	
28 Day Strength	79	MPa
28 Day Standard Deviation	3.5	

Heidrun tension leg platform
completed in July 1995



Aplikasi Beton Ringan



Masalah dari Platform Solar Terapung HDPE

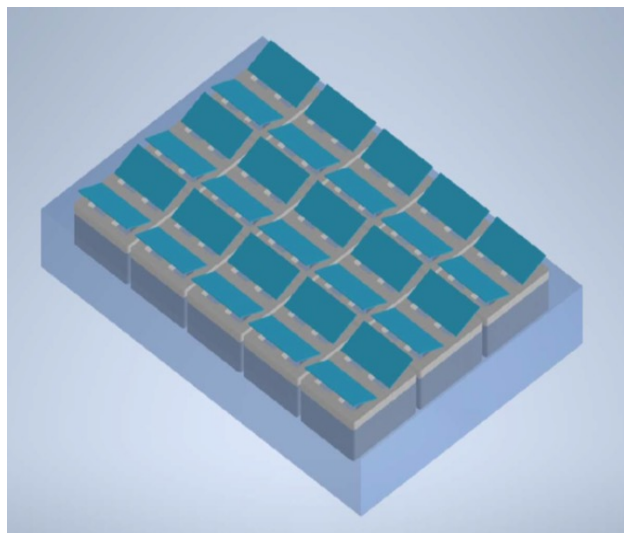


OCEAN SUN
The base of the Ocean Solar plant flexes as waves move underneath it

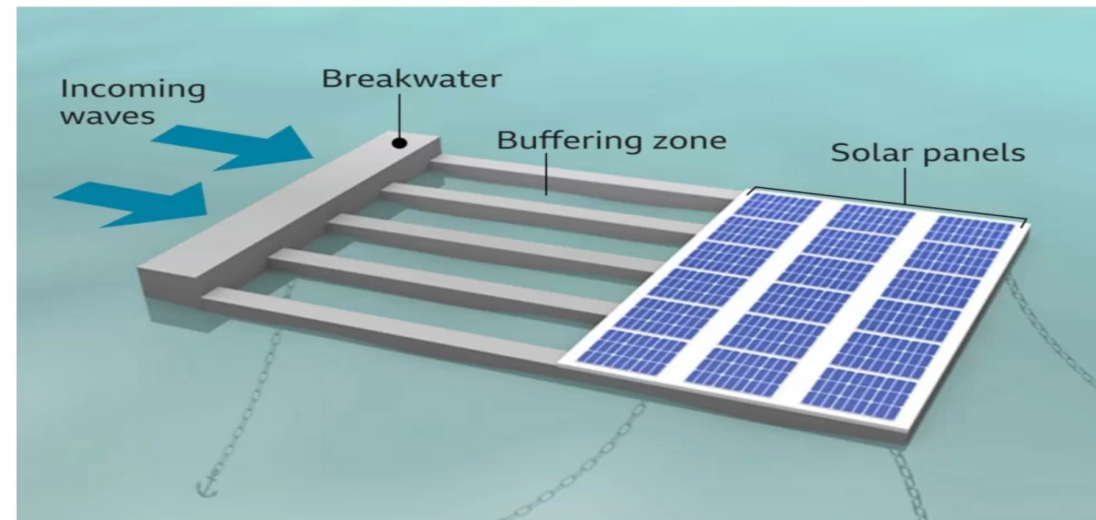


After the outermost row had ripped off the wind-facing edge did not have any ballast anymore to counter uplift from wind. The modules and floaters began to curl-up with the result of an electrical fire.

Image: Solar Power Plant Business / Nikkei Business Publications



The Solar2Wave system



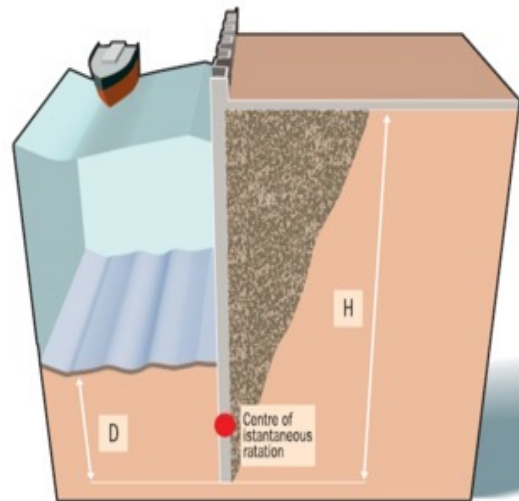
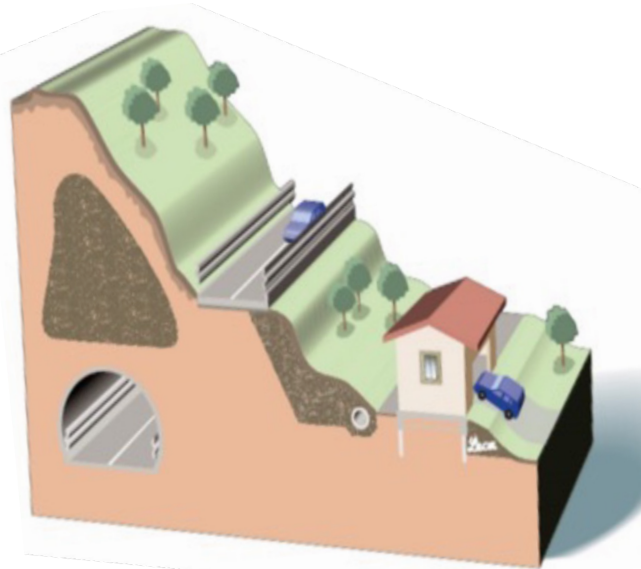
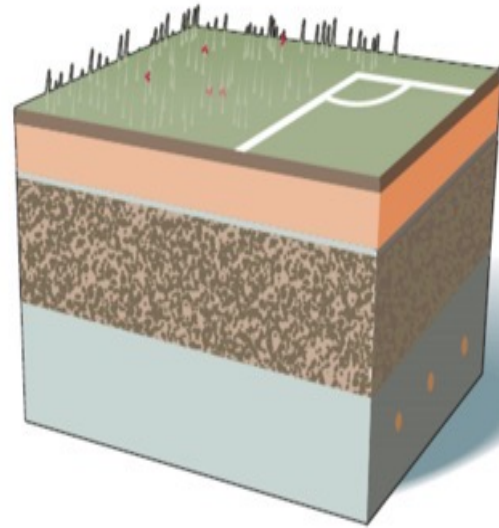
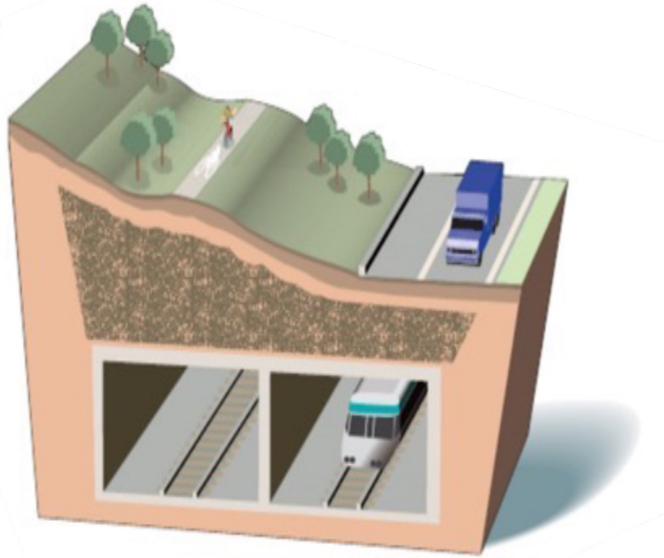
Source: Cranfield University

B B C

Performance	HDPE	LiGrA
Load Capacity	✗	✓
Stability	✗	✓
Contaminant to Water	✗	✓
Combustability	✗	✓
Durability	✗	✓

Aplikasi Lain dari Agregat Ringan Ramah Lingkungan

Geotechnical Applications



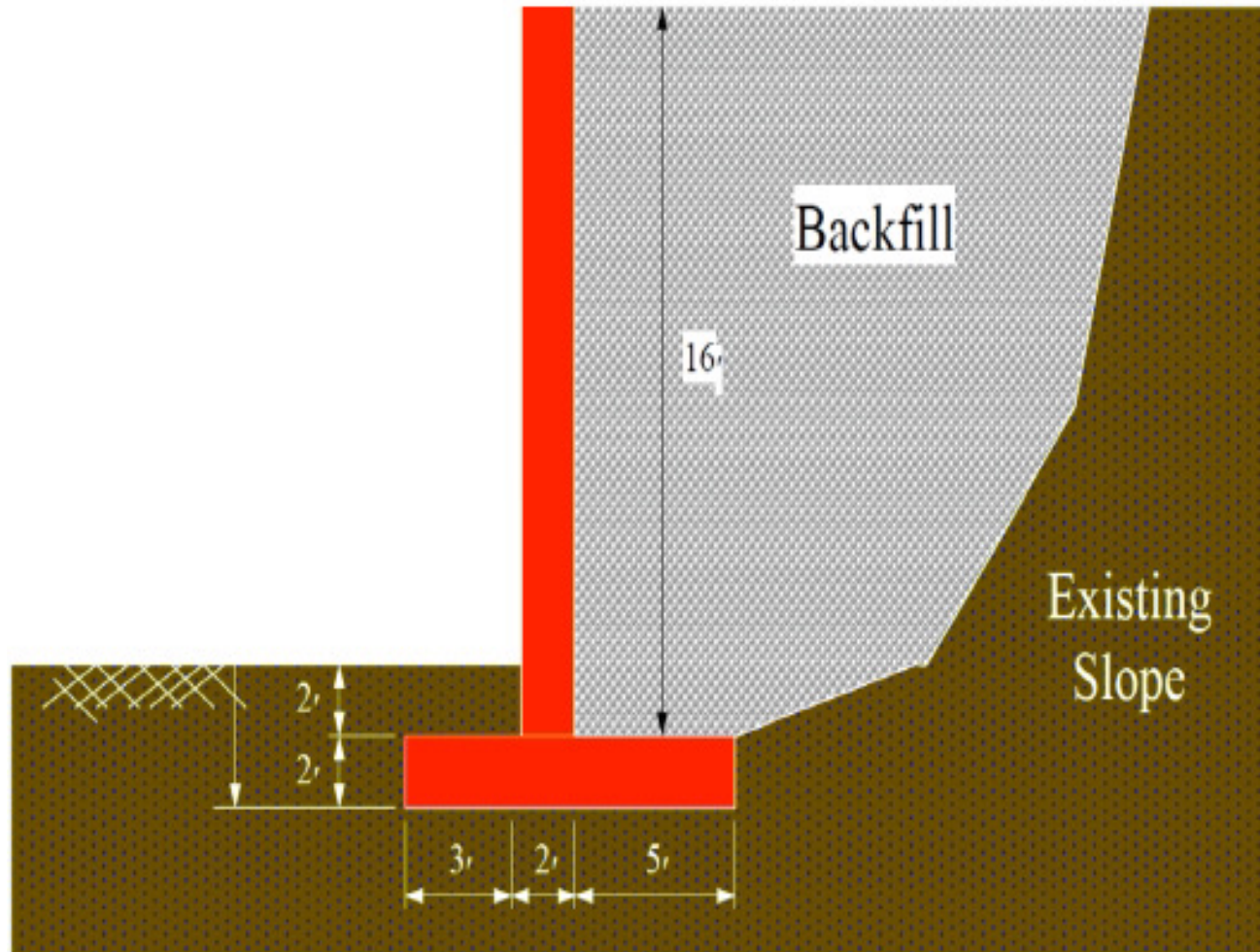
Roof Insulations



Sewage Treatment Plant



APLIKASI DINDING PENAHAN



Height of Wall	5m
----------------	----

	Normal Soil	LWA
Unit Weight	1900 kg/m ³	950 kg/m ³
Angle of Friction	30 deg	42 deg

Factor of Safety	Normal Soil	LWA
Overturning	2.8	6.2
Sliding	1.6	6.2
Bearing Capacity	2.6	6.3

Perbandingan efek penggunaan timbunan LW pada desain dinding

PERBANDINGAN NWC DAN LWC

	NWC	LWC
Sifat mekanik	★	
Ketahanan Termal		★
Berat (lebih ringan)		★
Daya tahan		★
Jejak Karbon		★
Harga Beton	★	
Menghemat Biaya Proyek		★
Keberlanjutan		★

Manfaat LWC vs NWC



Berat bangunan lebih rendah → Fondasi yang lebih rendah



Komponen pracetak yang lebih ringan & lebih besar. Rentang Lebih Lama → Biaya konstruksi & penghematan waktu

Manfaat LWC vs NWC



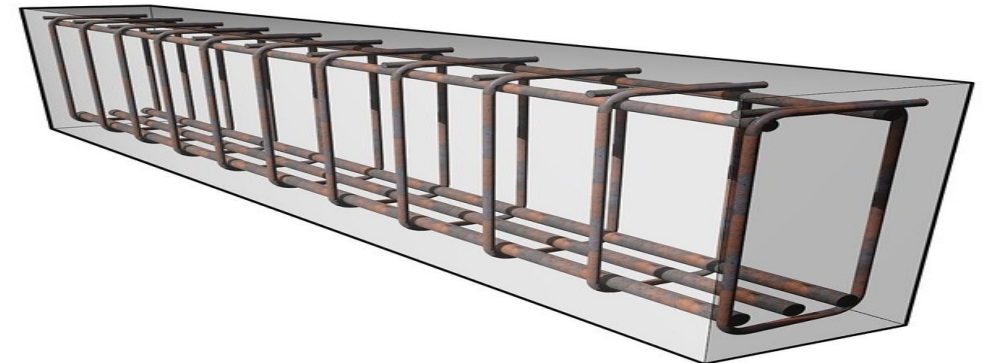
Daya Tahan Lebih Tinggi → Ketahanan lebih lama
Bangunan Lebih Ringan → Ketahanan gempa lebih baik



Ketahanan Termal Tinggi & Spesifik Kapasitas Panas Rendah →
Konsumsi AC lebih rendah & kondensasi lebih rendah



Ringan → Menghemat biaya transportasi



Berat beton lebih rendah → Penguatan Lebih Kecil

Manfaat Tambahan LiGrA vs NWC

- *Meningkatkan Keberlanjutan*
- *Mengurangi Emisi Karbon*
- *Memecahkan Masalah Pembuangan Limbah*
- *Mengurangi Eksploitasi Mineral Alam*
- *Menghemat Biaya*

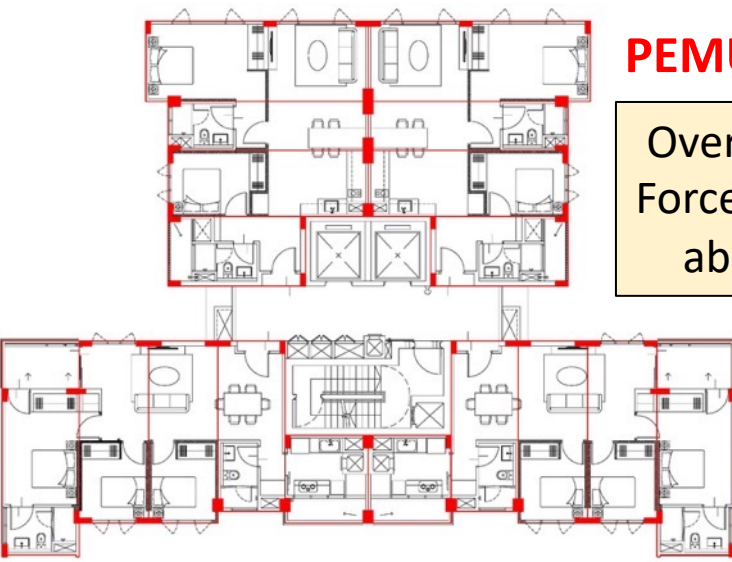


Mengurangi aktivitas Pertambangan

Daur Ulang Limbah – Meningkatkan Keberlanjutan



MANFAAT dibandingkan dengan NWC	Pengurangan Emisi Jejak Karbon	Menghemat Biaya
Daur Ulang Limbah	★	★
Mengurangi Eksploitasi Bahan Alam	★	★
Daya Tahan Lebih Tinggi	★	★
Bahan Baku dan Beton yang Lebih Ringan	★	★
Komponen Pracetak Lebih Ringan	★	★
Komponen Pracetak Lebih Besar	★	★
Pondasi Lebih Rendah	★	★
rentang yang lebih panjang	★	★
Penguatan Lebih Rendah	★	★
Ketahanan Gempa Lebih Tinggi	★	★
Ketahanan Termal Lebih Tinggi	★	★
Kapasitas Panas Spesifik Lebih Rendah	★	★
Mengurangi Kondensasi	★	★

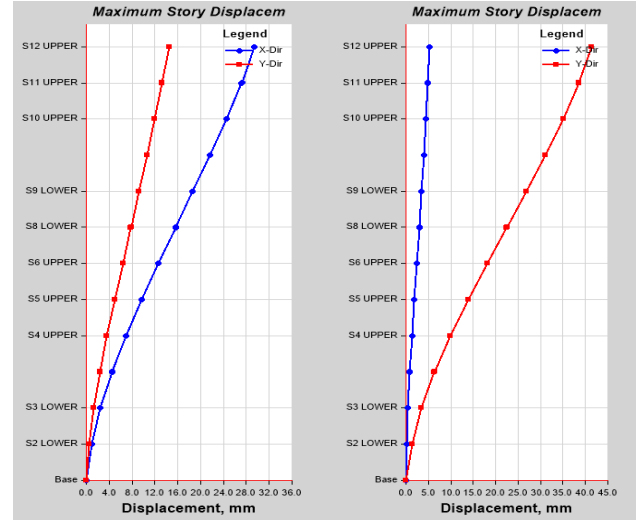


TYPICAL MODULE LAYOUT

PEMUATAN SEISMIK

Overall Seismic
Force Reduction
about 10%.

Beton Berat Normal

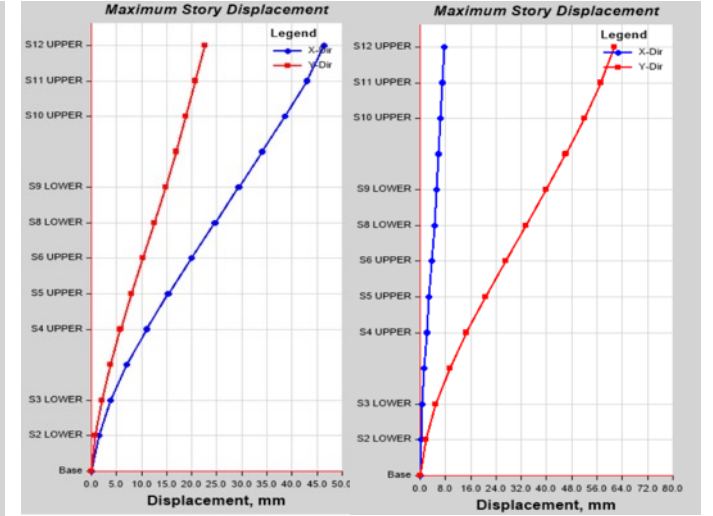


30mm

40mm

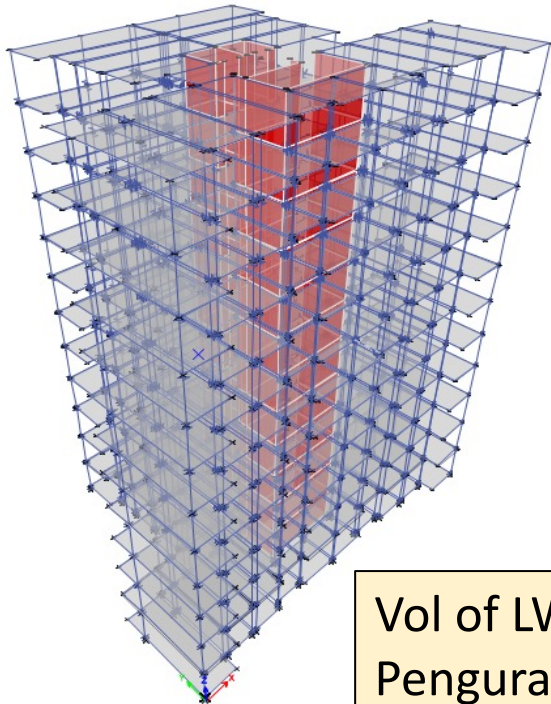
Allowance limit, 189mm (H/200).

Beton Ringan



46mm

60mm

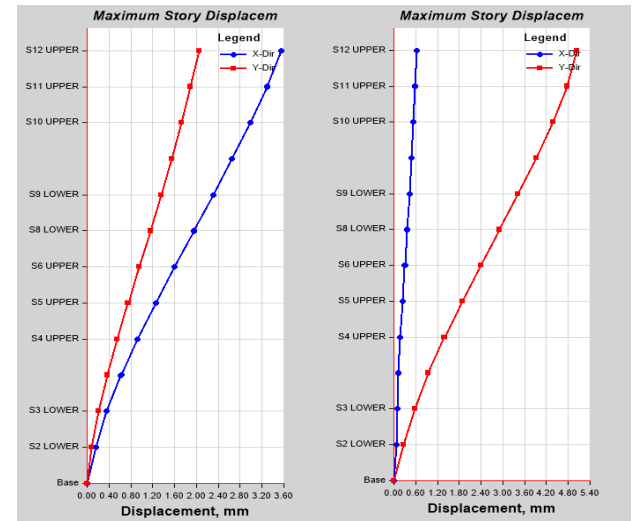


PEMUATAN ANGIN

STUDI KASUS

Density Class 1.6
Comp Str = 40 MPa

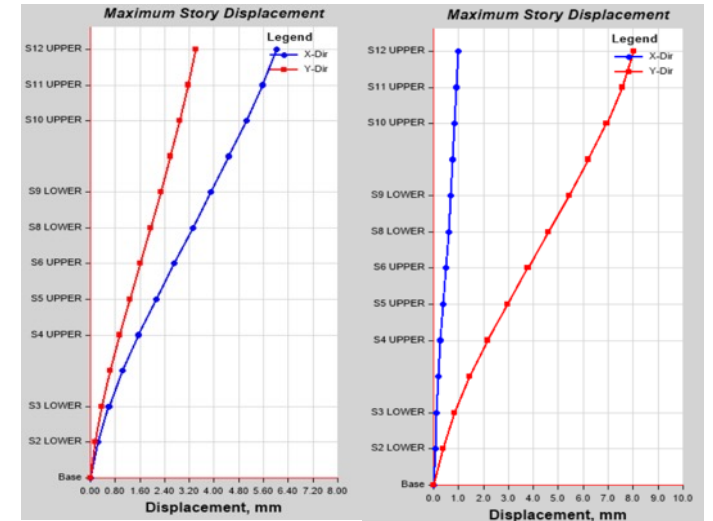
Vol of LWC = 1107m³
Pengurangan Beban = 830 ton



4mm

5mm

Allowance limit, 76mm (H/500).



6mm

8mm

Penghematan Biaya Dalam Menggunakan Beton Ringan

	Volume m ³	Cost SGD	
		NWA	LWA
CEMENT	0.145		
WATER	0.155		
SAND	0.3		
AGGREGATE	0.4	31.8	216

Perkiraan Biaya Konstruksi SGD

= 8,000 Sqft x 12 storey x SGD 350

= 33,600,000

Biaya Tambahan SGD

= 1107 x (216– 31.8)

= 203,909 (0.6% of construction cost)

These Benefits

1. Biaya pondasi karena pengurangan beban mati sebesar 830 ton
2. Biaya transportasi karena komponen pracetak yang lebih ringan
3. Biaya perawatan karena daya tahan yang lebih tinggi
4. Biaya energi karena isolasi termal yang tinggi
5. Ruang yang lebih besar, kolom yang lebih kecil
6. Beban mati lebih ringan, baja tulangan lebih rendah
7. Pengurangan Emisi Karbon yang Terkandung dan Operasional

Versus

Cost of LiGrA



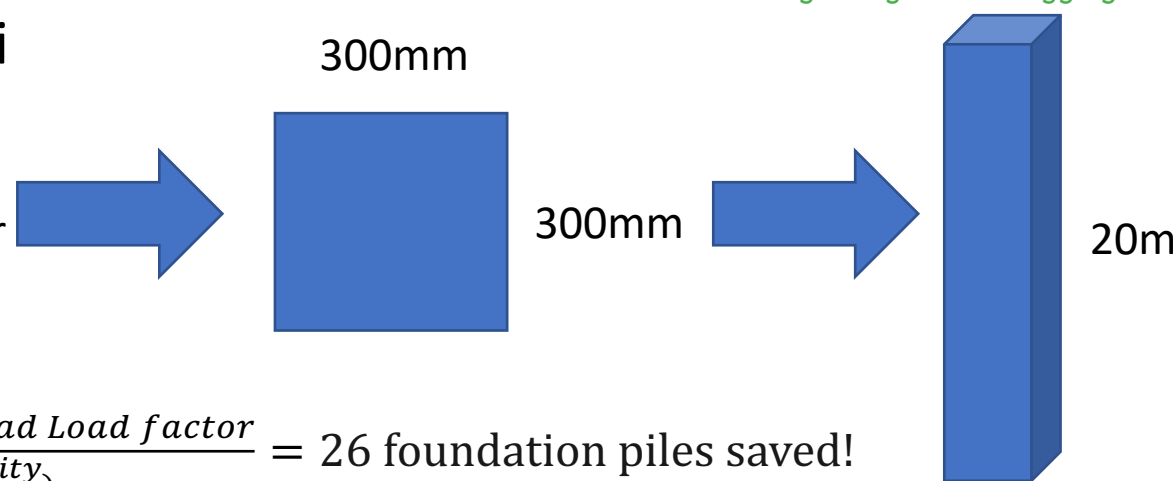
SGD 203,909

Penghematan Biaya Dalam Menggunakan Beton Ringan

1. Biaya pondasi karena pengurangan beban mati

Asumsi Foundation yang digunakan adalah 300 x 300mm square pile:

- Kapasitas Tiang Pancang yang diijinkan 90 nada per meter
- Factor of Safety (FOS) yang diterapkan adalah 2
- Tiang pancang akan didorong ke kedalaman 20m



Jumlah tumpukan yang disimpan: $\frac{\text{Reduction of applied load} \times \text{Dead Load factor}}{\left(\frac{\text{Allowable pile capacity}}{\text{FOS}}\right)} = 26 \text{ foundation piles saved!}$

Parameters/ Properties	Cost SGD/unit	Total Cost Savings SGD
Supply and installation of driven piles	61.80	32,136.00
Pile cutting cost and supply of capping plate	53.00	1,378.00
Installation of mild steel pile shoe	45.00	1,170.00
Total Foundation savings		34,684.00

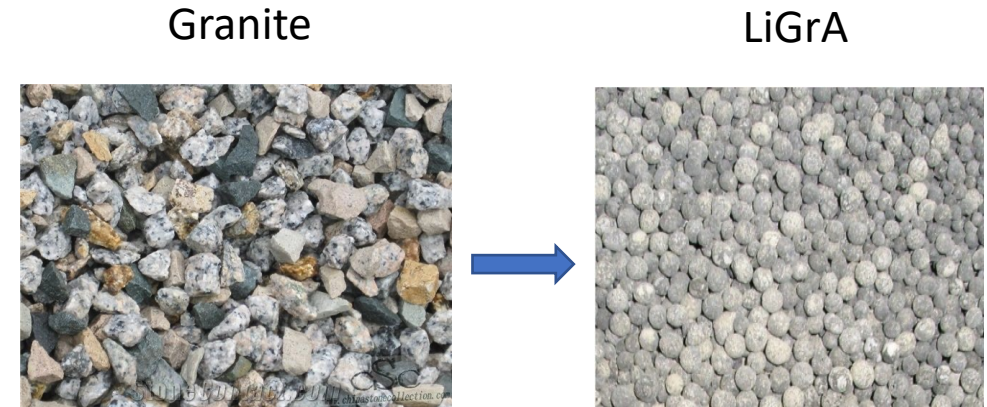
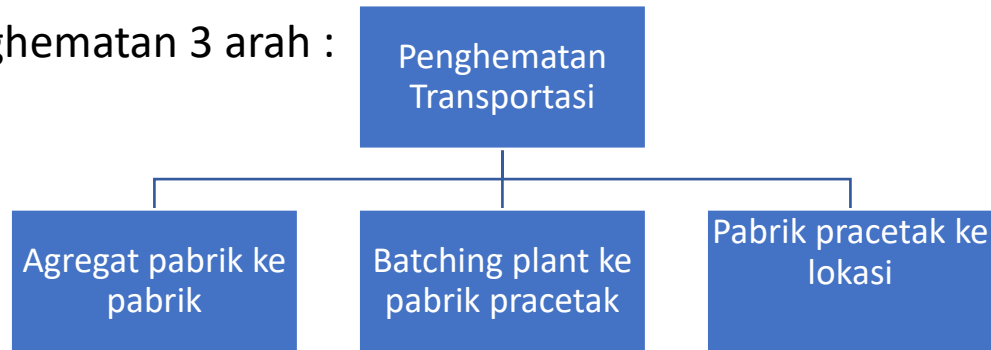
Perhitungan biaya didasarkan dari Jadwal Standar HDB Tarif untuk Pekerjaan Bangunan, Sipil Pekerjaan teknik dan kelistrikan

2. Penghematan Transportasi karena bahan yang lebih ringan dan komponen pracetak

Asumsi:

- Biaya transportasi sekitar 271.73 SGD
- Kapasitas truk 25 ton

Penghematan 3 arah :



Reduction of about $\frac{1}{8}$ to $\frac{1}{10}$ in weight

Pengurangan beban agregat 830 ton, jumlah truk yang dibutuhkan:

$$\text{No. of lorry required} = \frac{\text{Reduction in load (aggregates)}}{\text{Lorry capacity (tones)}} = 34 \text{ lorries saved!}$$

Parameters/Properties	Cost SGD/unit
Biaya transportasi	271.73/trip
truk yang dibutuhkan	34
Penghematan Transportasi	27,716.46

Selain penghematan finansial, juga akan mengurangi emisi karbon operasional yang disebabkan oleh truk.

3. Bobot Mati Lebih Ringan, baja tulangan lebih rendah

Asumsi:

- Persentase standar tulangan dalam beton sekitar 3%
- Dengan asumsi rentang 6m T-beam sebagai studi kasus untuk perbandingan yang relevan

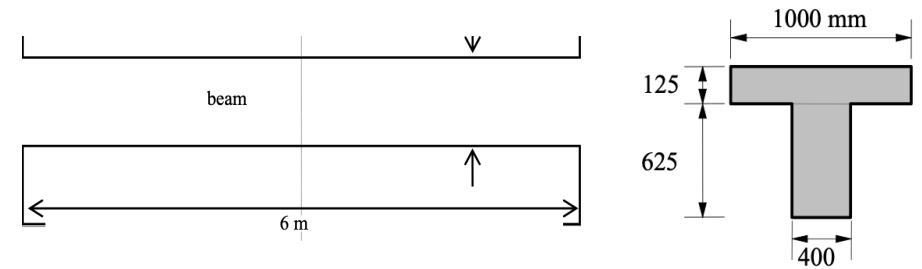
Beban Kerja:

NWC		LWC	
Dead Load	Live Load	Dead Load	Live Load
40 kN	30 kN	27.83 kN	30 kN

Costing for 6m span beam:

Massa baja tulangan	Massa Kg	Biaya/Kg	Biaya SGD/Kg
NWC	200.46	2.60	521.20
LWC	179.36	2.60	466.33
Pengurangan Biaya (SGD)			38.40

#Dengan asumsi pengurangan desain sengkang sekitar 30% dari Total tulangan tulangan



Menggunakan baja tulangan berdiameter 12mm untuk mendesain:

Reinforcement size	Position	NWC	LWC
N12	I – End Boot	10	9
	Mid Boot	18	16
	I – End Boot	10	9

Using LWA, the percentage of reinforcement steel is reduced by approximately 10.53%. This percentage can be utilized to calculate the cost savings for the case study.

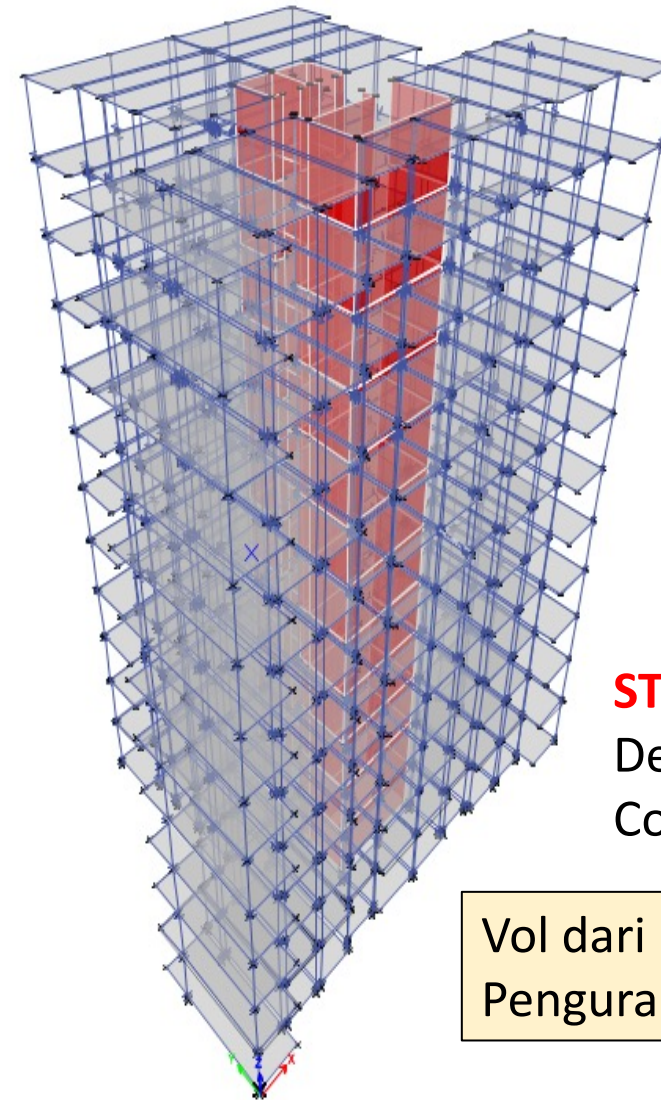
Penghematan Biaya Dalam Menggunakan Beton Ringan

Asumsi:

- Aturan praktis jumlah baja untuk Beton Bertulang = 3%
- Kepadatan baja diambil sebagai 7.850 kg/m³

Parameter	Massa /Ton	Biaya 2.60 SGD/ kg
NWC	260.70	677,820
LWC	233.26	606,470.53
Savings	27.44	71,349.47

Dengan menggunakan LiGrA, jumlah 71.349,47 SGD dapat dihemat berdasarkan studi kasus ini. Berat sendiri struktur mengurangi beban mati bangunan. Dengan beban mati yang lebih rendah, diperlukan tulangan baja yang lebih sedikit untuk Beton Bertulang.



STUDI KASUS

Density Class 1.6

Comp Str = 40 MPa

Vol dari LWC = 1107m³
Pengurangan Beban = 830 ton

4. Biaya Energi karena isolasi termal yang tinggi

Asumsi :

- Penghematan energi untuk AC ruangan diukur dengan Energy Efficient Ratio (EER)
- Tarif listrik untuk rumah tangga sebesar SGD 0,30 per kWh – Energy Market Authority (2022)
- Unit AC "Daikin MKS65TVMG" menyalurkan 4 Indoor Unit (IDU) untuk 4 kamar susun (HDB)
- Luas lantai studi kasus adalah 8000 Sq Ft atau 743,22 Sqm

Parameters	NWC	LWC
Concrete Density (Kg/m ³)	2350	1600
Material Conductivity, k (W/m/K)	1.16	0.54

Penurunan sebesar 53,45%
dari beton berat normal
(NWC)

For AC unit with $21,200 \frac{Btu}{hr}$ = Cools down 4 room flats of HDB (85-93 Sqm)

Parameters	4-room flats (Reference)	Case Study PPVC
Floor area (Sqm)	93	743.22
Energy usage by Air- Conditioning Unit (Btu/hr)	21,200	169,422

Angka ini mewakili kapasitas
AC. Mengetahui kapasitas,
bagaimana kita menemukan
Daya W diserap oleh AC?

5. Biaya Energi untuk isolasi termal yang tinggi

Dengan asumsi Energy Efficient Ratio (EER) dari 10:

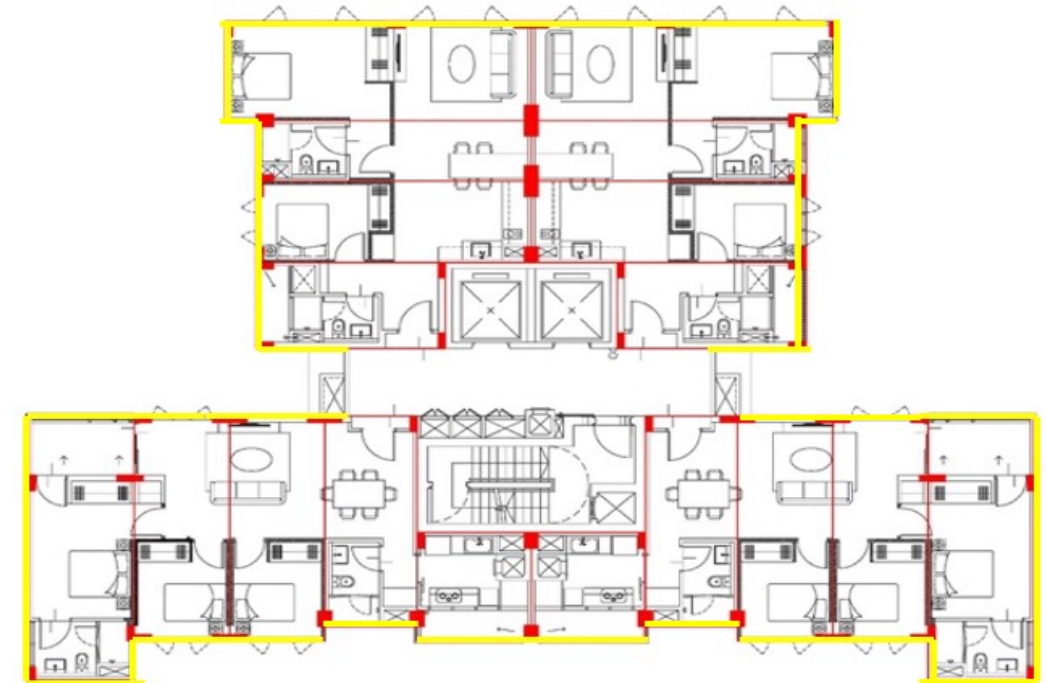
$$EER = \frac{\text{Output cooling energy (BTu)}}{\text{Input electrical energy (Whr)}}$$

$$\text{Input electrical energy} = 16942.2 \text{ W}$$

Input Electrical Energy for LWC (Watt)

$$(100-53.45)\% \times 16942.2 \text{ Btu/hr} = 7886.60 \text{ W}$$

Parameters/Properties	NWC	LWC
Power Consumption W	16,942.2	7886.60
Energy Consumed kWh/Day	406.61	189.28
1kWh Cost SGD	0.30	0.30
Energy Cost/Yr SGD	43,914.18	20,442.06
Energy Cost Savings SGD/Year	23,472.11	
Energy Cost Savings 30 year	234,721.10	



TYPICAL MODULE LAYOUT

Penggunaan LiGrA, konsumsi energi oleh unit AC dapat dikurangi. Penghematan berdasarkan studi kasus ini berjumlah SGD 234.721,1 selama 10 tahun. Temuan ini didukung dengan sifat LiGrA yang memiliki isolasi termal yang tinggi.

6. Ruang yang lebih besar, kolom yang lebih kecil

Berdasarkan penghematan dari Reinforcement Steel, menggunakan LWA :

- Membangun berat badan sendiri akan berkurang
- Kolom yang lebih kecil diperlukan untuk mentransfer secara struktural memuat dari balok
- Jumlah kolom yang lebih sedikit



Normal Weight Aggregates

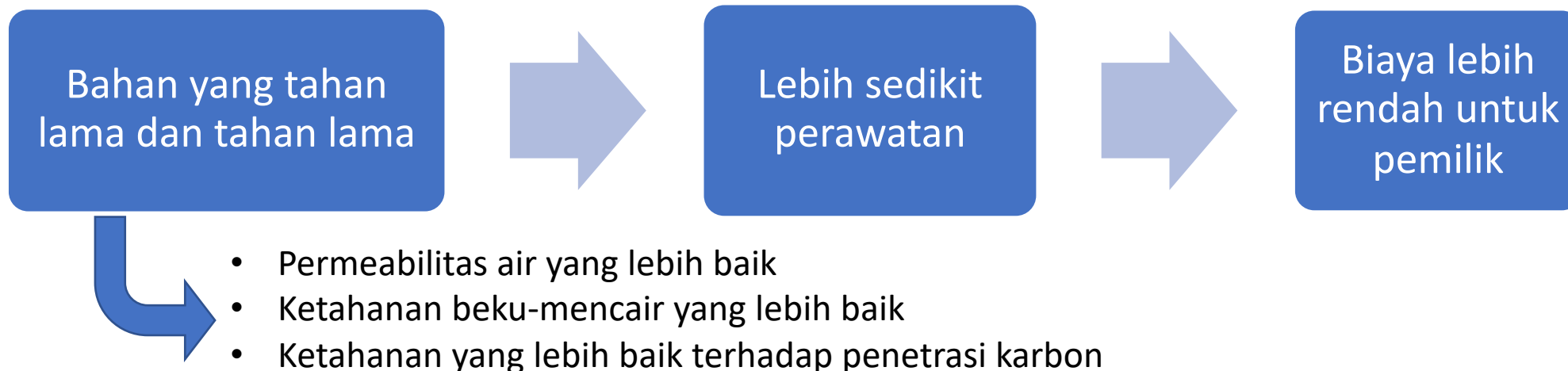


Light Weight Aggregates

Perbandingan	NWC	LWC
Jarak antar kolom	↓	↑
Efisiensi Desain	✗	✓
Biaya dioptimalkan	✗	✓

7. Biaya Pemeliharaan karena daya tahan yang lebih tinggi

Bagaimana penggunaan LiGrA membantu mengurangi biaya pemeliharaan dan perbaikan?



Metode Kerusakan	Solusi	Cost SGD
Penetrasi air	Perbaikan kebocoran dinding eksternal (PU Grouting)	400-800 (Exc. GST)/m2 of crack
Kerusakan beku-mencair	Sealer beton	1.25 to 1.75/ Sqft
Jamur di dinding karena kondensasi	Remediasi cetakan	3500/Service

Dengan memanfaatkan LiGrA, kami dapat mengurangi tingkat pemeliharaan, yang akibatnya menurunkan biaya pemeliharaan struktur.

Total Penghematan terhadap Total Biaya Tambahan

Penghematan	Penghematan LWC	Faktor Pengurangan	Penghematan Biaya SGD
Pembangunan	Foundation Cost	Pile Usage	34,684.00
	Transportation Cost	Lorries	27,716.46
	Reinforcement Cost	Steel Reinforcements	71,349.47
Operasional	Energy Cost	AC Unit Electricity	234,721.10
	Total Penghematan (SGD)		368,471.03



Total Biaya Tambahan sebesar **SGD 203,909.00**

Total penghematan biaya:
 Tidak termasuk biaya dari biaya perawatan
 Mengurangi emisi karbon yang terkandung dan operasional
 lebih dari biaya tambahan yang harus dikeluarkan jika LiGrA digunakan.

Pengurangan Emisi Karbon Menggunakan LiGrA

Kandungan Karbon - The ICE Database	kg CO ₂ e / kg
LiGrA	0.278
Granite Agg	0.00438
LECA	0.393

Additional CO₂e due to use of LiGrA = 123.1 ton CO₂e
 Additional CO₂e due to use of LECA = 168.9 ton CO₂e

Pengurangan Emisi Karbon yang terkandung	ton CO ₂ e
Pengalihan Limbah kaca dari pabrik insinerasi	436.6
Penghematan dari Transportasi	9.7
Pengurangan Tulangan Baja	145.3
Pengurangan Pondasi	28.0
Total	619.6

Pengurangan Emisi Karbon Operasional	ton CO ₂ e
Penghematan penggunaan energi AC (/tahun)	38.6
Usia Bangunan lebih lama	
Pengurangan Pemeliharaan	
Total	38.6
In 30 years, reduction = 1,158 ton CO ₂ e	

Sources: (1) ICE DB V3.0 (Embodied Carbon of Materials), (2) NEA 5th Biennial Report 2022, (3) IPCC Transport tool Version 2.6, (4) IGES List of Grid Emission Factors 2021, (5) Korea LCI Database

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