



Reducing Carbon at the Design Stage

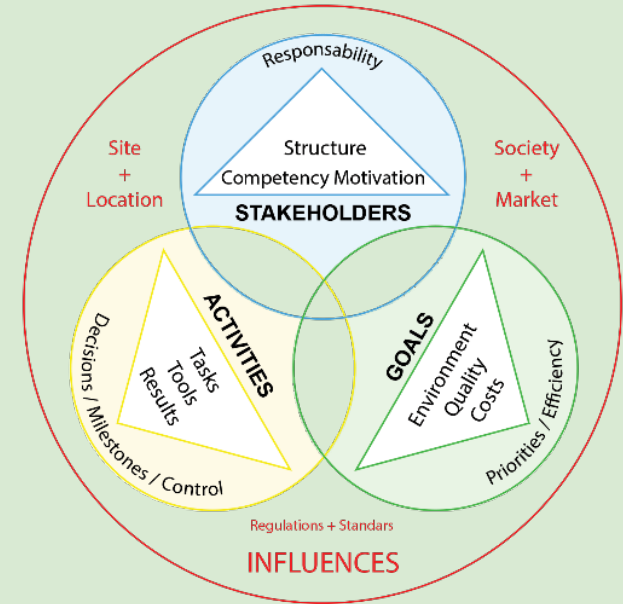


Where are we at?

- Buildings represent 39% of global greenhouse gas emissions, including 28% in operational emissions and 11% in building materials and construction.
- In 2021 energy consumption and emissions rebounded to above 2019 values (before COVID)
- The highest growth of construction is expected into areas less reached by technology, where means of immediate reduction of embedded carbon might not be available, or too expensive (IPCC)
- All major organizations ask for urgent actions to reduce emissions of new and existing buildings.

Integrated Design Process

All stakeholders involved in the building supply chain should feel responsible and committed, by thinking on “how” to influence efficiently the whole process, from the initial project conception to the execution and maintenance of its single parts, through an Integrated Design Process (IDP)



Stakeholders



GOVERNMENTS



DEVELOPERS



CONSULTANTS



CONTRACTORS



Certification Bodies



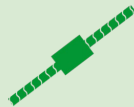
Universities



Labs



BIM companies



**Material
Manufacturers**

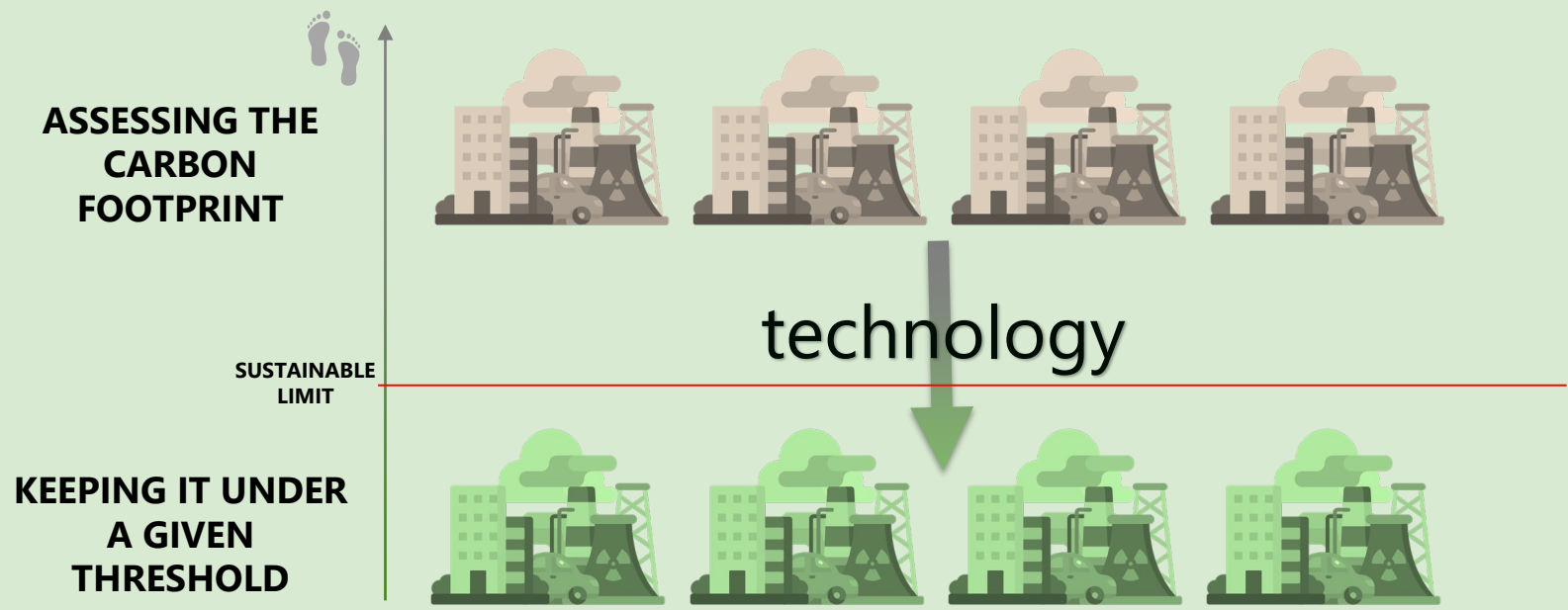


Norms/committees



**Fabricators and
Installers**

How? Building Efficiently

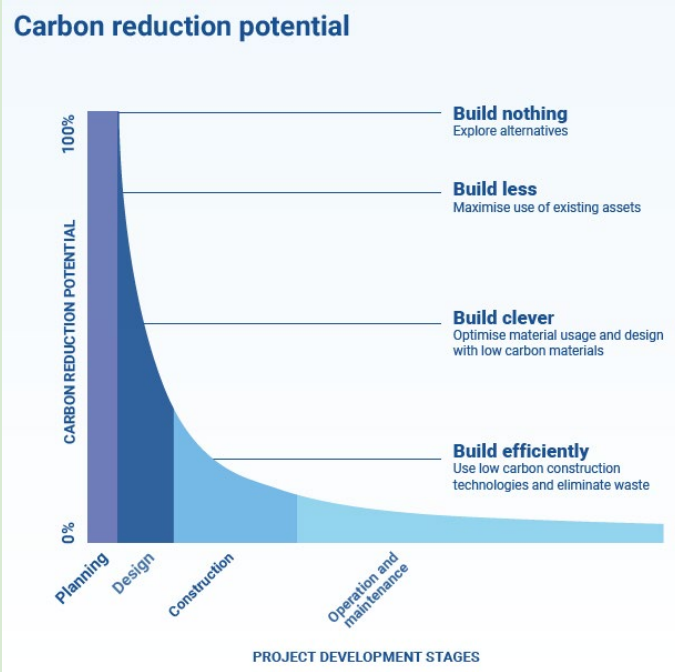


How? Building Efficiently

IS THIS APPROACH EFFECTIVE ENOUGH?

**WHAT HAPPENS IN THOSE AREAS OF NEW EXPANSION, WHERE
TECHNOLOGY IS NOT AVAILABLE?**

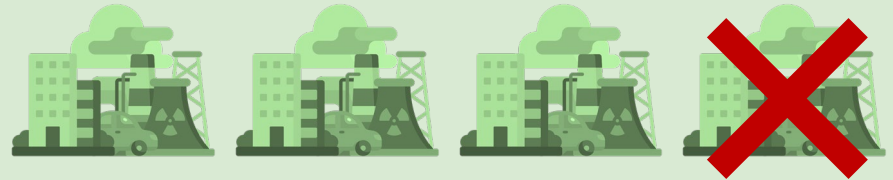
Reducing footprint at the design stage



The highest influence to reduce embodied carbon is in the design stage (WGBC 2019)

Challenge: to find highly effective structural solutions, in other words...

REMOVING CAUSES!



Build Clever: The STARS vision

STARS is an original project presented for the first time in **DUBAI** on March 25th 2022 with the support of several organizations.

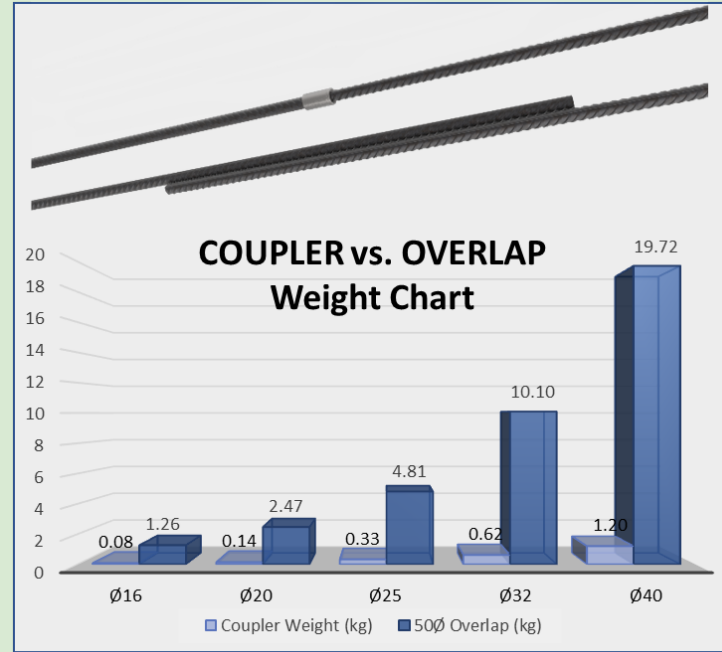


STARS is showing **HOW** a more efficient structural design may reduce the causes of the carbon footprint, consistently and immediately, while increasing the durability of the construction

The STARS vision

The idea is simple, and it is based on **replacing overlap, the most traditional way to connect reinforcing bars, with mechanical splices**, which are known and used since more than 50 years.

For each overlap, an average rebar length of 50 times the rebar diameter may be replaced by a coupler, way much lighter (the smaller, the better), ensuring the continuity of the rebar .



Overlap vs. Mechanical Splices



A mechanical splice is a device to join two reinforcing bars with the capacity to transfer the full tension from one to the next.

The most popular splice is the threaded system, with two rebars threaded and connected through a coupler sleeve

With rebar preparation



Without rebar preparation



Technical advantages

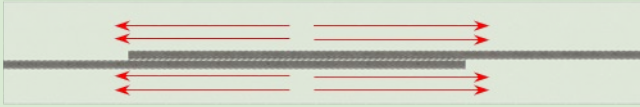
SAFE SOLUTION

Loads are not depending on
surrounding concrete
(continuous rebars)



Traditional Overlap vs. Mechanical Splices

Traditional Overlap



Loads are transferred by the bonding of surrounding concrete.

In absence of concrete, the rebar system loses its connections and fails



Mechanical Splices



Loads are transferred through the splice with or without the surrounding concrete.

In case of concrete failure the rebar behaves like a continuous one



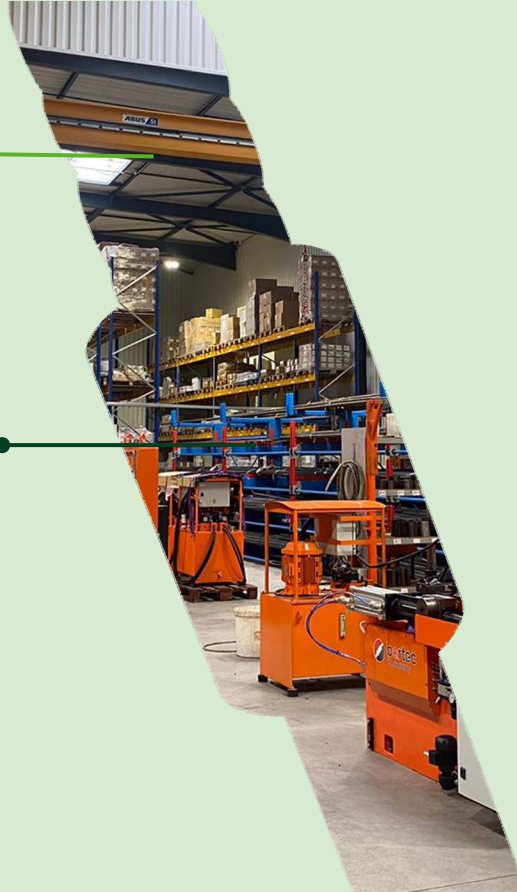
Technical advantages

SAFE SOLUTION

Loads are not depending on surrounding concrete (continuous rebars)

CERTIFIED

It is a well-know and certified technology



Certification of mechanical splices

A sustainable design should guarantee safety to all projects, especially when a structural failure could end up in a major disaster with casualties involved



Public Structures

High rise buildings,
stadiums, iconic buildings



Infrastructures

Viaducts, bridges,
Metro Lines, Docks



Power Plants

NPP, Windmills, etc..

Certification of mechanical splices

A certification from an independent body ensures:

Full traceability and marking



Quality control



Continuous random testing



Regular audits to the coupler manufacturing facilities and downstream facilities



A CERTIFIED mechanical splice delivers top safety to the whole project

Technical advantages

SAFE SOLUTION

Loads are not depending on surrounding concrete (continuous rebars)

DURABILITY

Bonding of surrounding concrete provides durability, stronger against earthquakes

CERTIFIED

It is a well-know and certified technology

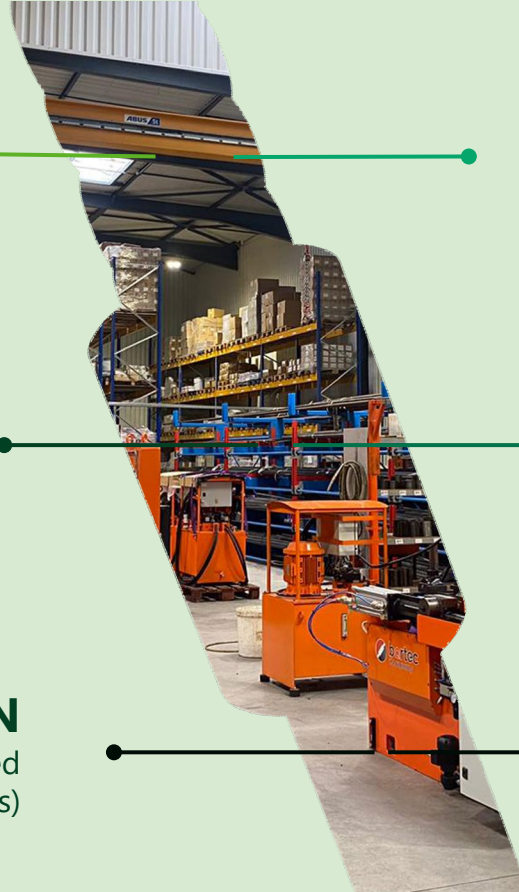
DESIGN FLEXIBILITY

(smaller sections)

AVOID CONGESTION

(better quality of finished elements)

FORMWORKS SAVING



Constructive Advantages

**PREFABRICATING
REBAR CAGES**

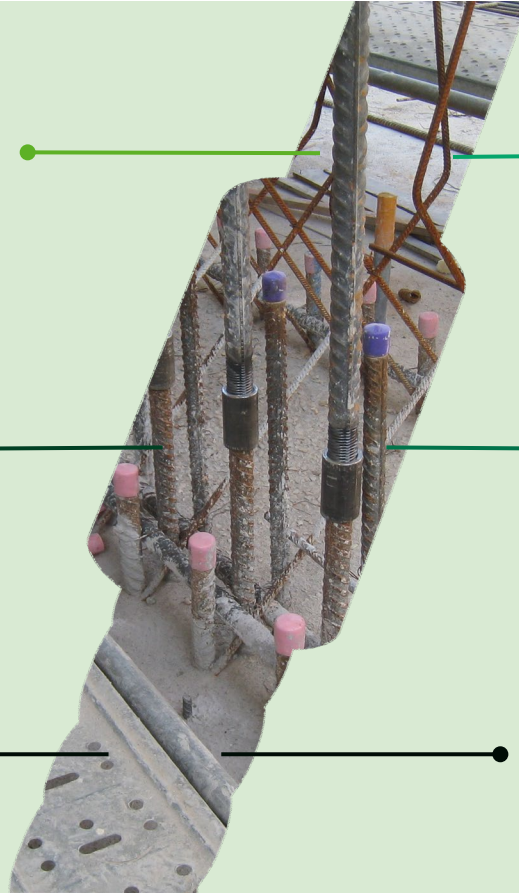
**LESS SPLICES IN
LONGER ELEMENTS**

**ALLOW CLIMBING
FORMWORKS**

**PRECAST CONCRETE
ELEMENTS**

**D-WALLS AND
TOP-DOWN
STRUCTURES**

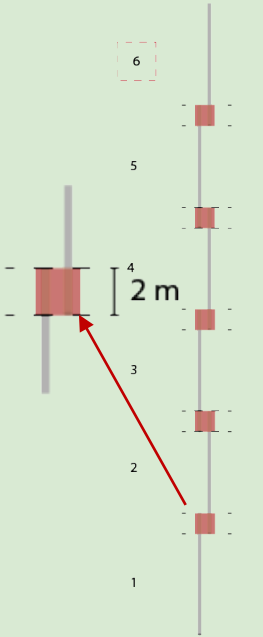
**SAFETY : LESS
PROTRUDING REBARS**



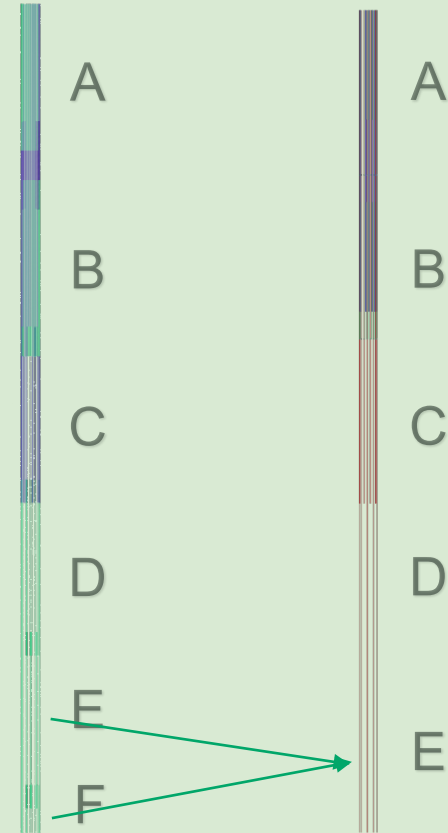
Less Splices in Longer Elements

OVERLAP
5 joints

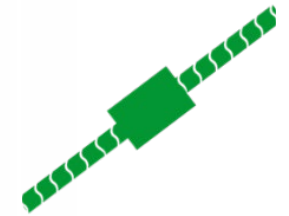
COUPLER
4 joints



**INCREASED
EFFICIENCY FROM
LESS OPERATIONS!**



Mechanical Splices are SUSTAINABLE



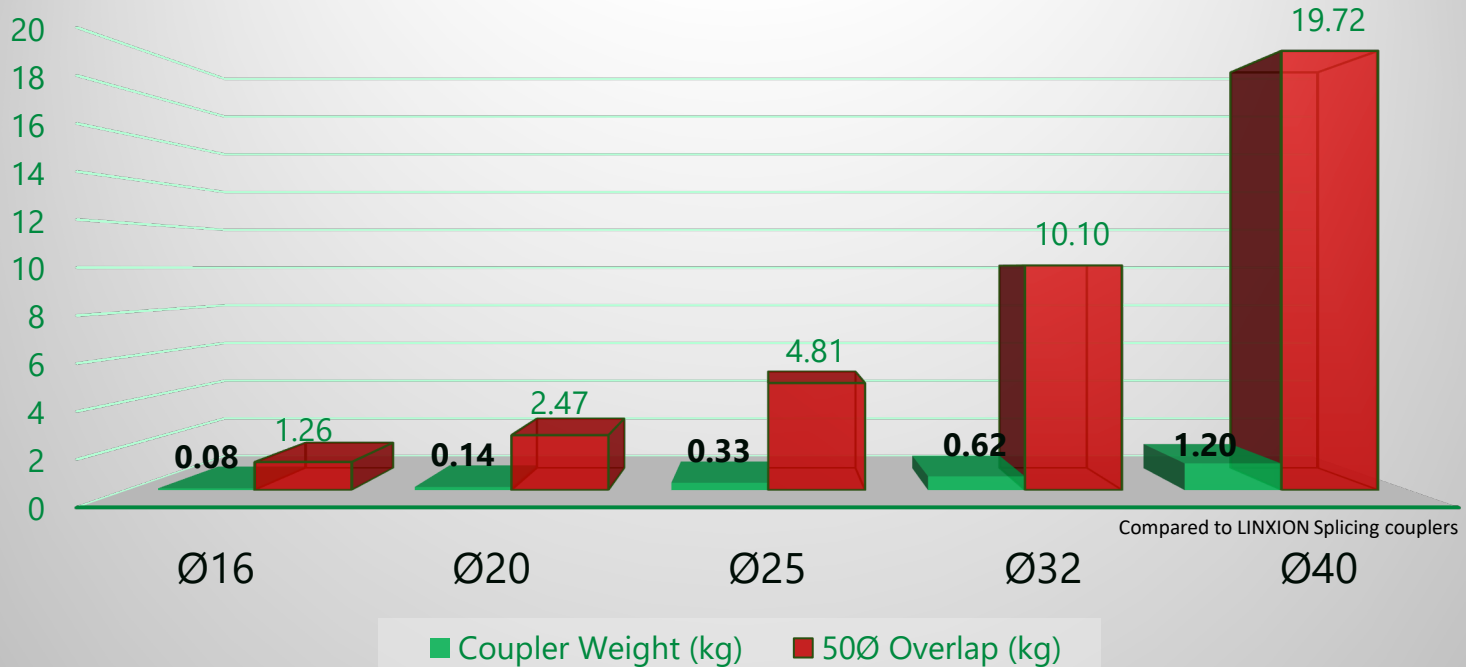
Until now Mechanical Splices have never been seen as a possible vehicle to reduce the steel amount in concrete elements, and what goes along with in terms of emissions, less trucks on the roads, etc...

Today we are understanding the sustainability of a safe and **well-known technology** that may bring a lot of benefits to the environment

SPLICING TECHNOLOGY ALLOWS REDUCTION OF STEEL

Weight Chart

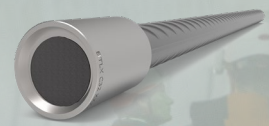
Coupler vs. Overlap



Case study : GRAND PARIS

320.000 Couplers delivered

by BARTEC COMPANY in 2021
only for rebars dia. 16-40 mm

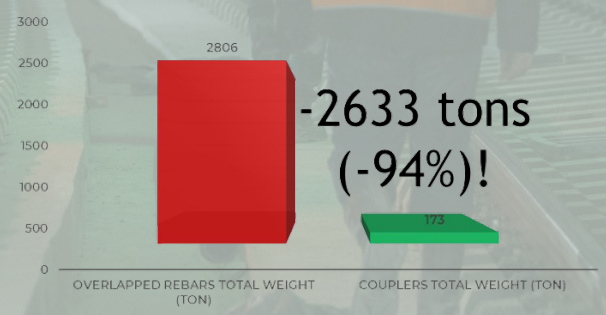


Mechanical splices have been specified and used only for a few applications, and not to replace every single splice.

Used Couplers vs. Equivalent Overlap



Total Steel Volume

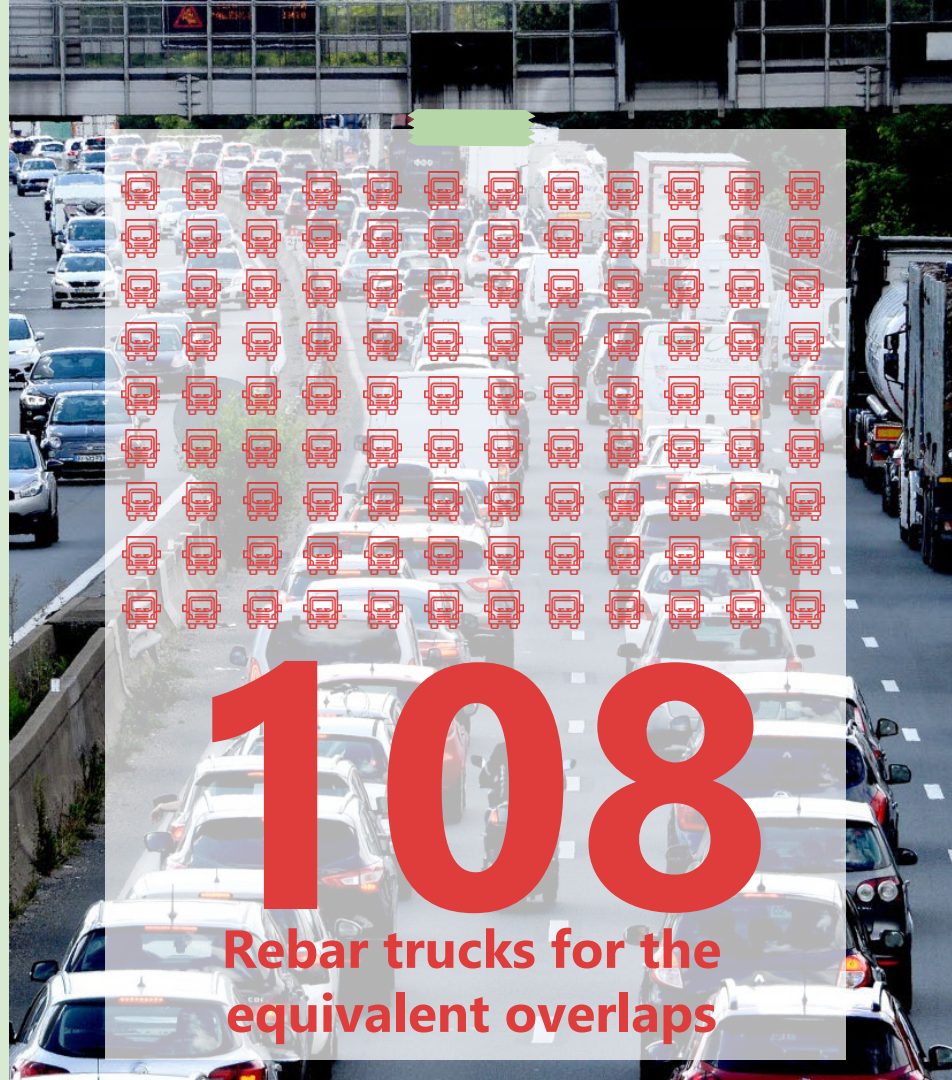


Compared to LINXION Splicing couplers



8

Couplers trucks



108

Rebar trucks for the equivalent overlaps

Exploring the potential of mechanical splices

- **Mechanical Splices are a sustainable solution compared to Overlap**
- **Most of the biggest projects use couplers for a limited amount of applications**
- **Technically speaking, mechanical splices are superior to the traditional overlap**
- **Certifications guarantee the splicing performance**
- **Mechanical splices are considered an expensive solution (is that true?)**



What if ALL Overlaps were replaced by Mechanical Splices ?



All overlaps replaced by mechanical splices



18 storey building

(1823 t Rebars in different sizes)

With **94 831**
Mechanical splices :

-372 tons of steel

-20%



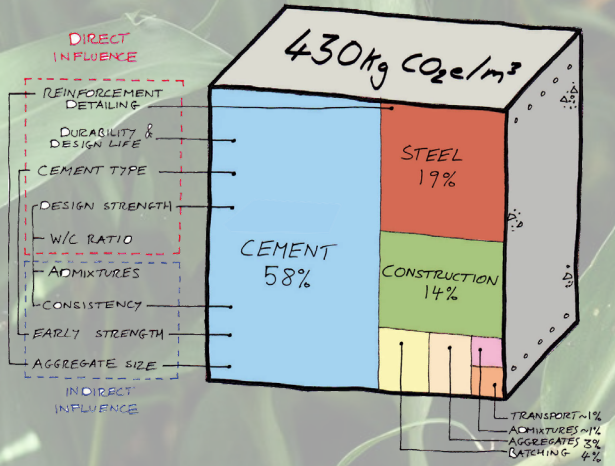
Two towers bridge

(3783 t Rebars in different sizes)

With **142 870**
Mechanical splices :

-913 tons of steel

-24%



20% of 19% means...

Nearly 4%
IMMEDIATE REDUCTION
of the embedded carbon in each
reinforced concrete building

Breakdown of embedded carbon in a finished building

Focus on UAE

Dubai was chosen for the first presentation of STARS in March 2022 for three reasons:

- 1) United Arab Emirates are well known for the large number of futuristic and innovative construction projects,
- 2) UAE is in the front line for the 2050 Net Zero emission achievement and will host COP28 this year;
- 3) Certified mechanical splices are used extensively in UAE, its market prices became quite low compared to European and American markets, therefore it is a better scenario for analysing the economic impact of a total replacement of overlaps.

Focus on UAE



Deira waterfront

AS MADE **-1%** steel
(some mechanical splices)

POTENTIAL **-18%** steel
(100% mechanical splices)



Bloom Towers

AS MADE **-6%** steel
(some mechanical splices)

POTENTIAL **-18%** steel
(100% mechanical splices)



Al Warqa Mall

AS MADE **-4%** steel
(some mechanical splices)

POTENTIAL **-20%** steel
(100% mechanical splices)

Cost increase for "All splices" structures

Overlap cost

- Extra Rebar Volume
- Steel rod
- Extra stirrups
- Transport Cost
+ Overlaps, + Rebars, + Trucks
- Formworks preparation
- Longer operations
- Longer construction
- Cost of the steel may change

Price for the end user is variable !

Mechanical splices cost

- **1 COUPLER**
- **2 THREADS**

Price for the end user is fixed !

Cost increase for "all splices" structures



Deira waterfront

AS MADE **-1%** steel
(some mechanical splices)

POTENTIAL **-18%** steel
(100% mechanical splices)

+0.5%



Bloom Towers

AS MADE **-6%** steel
(some mechanical splices)

POTENTIAL **-18%** steel
(100% mechanical splices)

+0.7%



Al Warqa Mall

AS MADE **-4%** steel
(some mechanical splices)

POTENTIAL **-20%** steel
(100% mechanical splices)

+0.4%

Cost Impact

- The cost impact of “all” mechanical splices is around 0.5% on the total cost of the building
- This difference might disappear after considering volume increase and hidden costs of overlap
- Even at the present conditions we are talking about a few USD/sqm...a price low enough to disappear in the supply chain

Should we use a solution providing...

4% REDUCTION OF EMBEDDED CARBON

— IMMEDIATE EFFECT

ELIMINATE FOOTPRINT CAUSES

MORE DURABLE BUILDINGS

● POSITIVE SIDE EFFECTS

AVAILABLE EVERYWHERE

ALMOST AT THE SAME COST

Answer



YES, WHAT ARE WE WAITING FOR?

Thank You

Do you have any questions?

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