
GREENRAIL™

PROBLEM OVERVIEW

THE CONVENTIONAL RAILWAY SUPERSTRUCTURE CONSISTS OF RAILS, ELASTIC FASTENING SYSTEM AND, IN GENERAL, CONCRETE SLEEPER SUPPORTED ON BALLAST BED. SUCH TRACKS HAVE A LOW CONTACT ELASTICITY BETWEEN SLEEPERS AND BALLAST.

VIBRATIONS, INCREASED VEHICLE AND AXLE LOAD, CAUSE A FAST EXTENSIVE WEAR ON THE CONTACT AREAS AND BALLAST PULVERIZATION. THIS RAPID DECLINE OF THE TRACK QUALITY REQUIRES THE SHORTENING OF TRACK GEOMETRY MAINTENANCE CYCLE THUS INCREASING THE MAINTENANCE COSTS.

GREENRAIL SLEEPER WITH ITS ELASTIC OUTER SHELL IS THE SOLUTION TO THESE PROBLEMS, ENSURING A BETTER LOAD DISTRIBUTION OF THE LOAD IN THE TRACK STRUCTURE.

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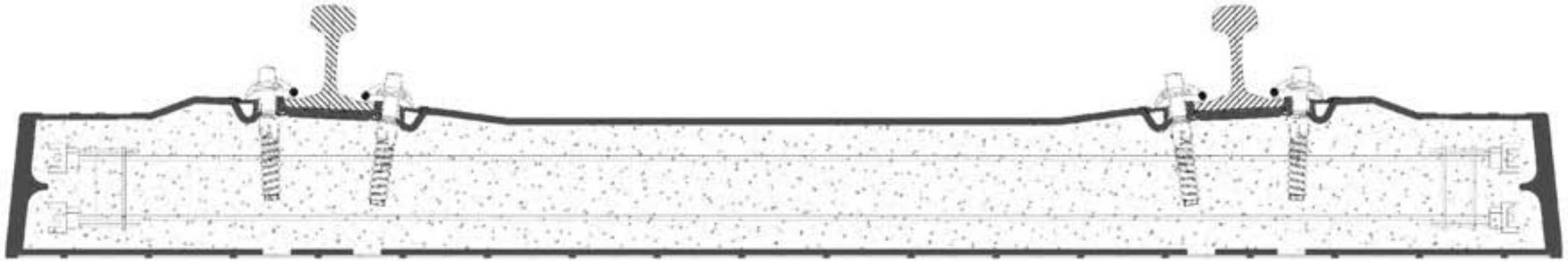
GREENRAIL SLEEPER

- *GREENRAIL™* SLEEPER IS COMPOSED BY AN OUTER SHELL OBTAINED FROM A MIXTURE OF ELTs (END OF LIFE TYRES) AND RECYCLED PLASTIC, WITH AN INNER CORE IN PRESTRESSED CONCRETE.
- *GREENRAIL™* IS A **TAILOR MADE** PRODUCT AND IT CAN BE DESIGNED ACCORDING TO ANY TECHNICAL SPECIFICATION.
- *GREENRAIL™* IS THE ONLY COMPOSITE SLEEPER DESIGNED FOR «W» FASTENING SYSTEM PRE-ASSEMBLED IN FACTORY.
- COMPATIBLE WITH CONVENTIONAL PROCEDURES AND EQUIPMENT FOR THE CONSTRUCTION AND MAINTENANCE OF THE TRACKS.



GREENRAIL IS A *TAILOR-MADE PRODUCT*, WHICH ALLOWS TO REALIZE ANY TYPE OF SLEEPER ACCORDING TO THE CUSTOMER SPECIFICATION.
ITS PECULIAR STRUCTURE MAKES IT THE ONLY COMPOSITE SLEEPER SUITABLE FOR CONVENTIONAL AND HIGH SPEED RAILWAY LINES.

GR 260 W	VALUE	UNIT
Dimensions (width x height x length)	300 x 264 x 2400	mm
Weight	330	kg
Permissible axle loads	32	Ton
Maximum speed	250	Km/h
Concrete grade	50/60	

GR 240 W	VALUE	UNIT
Dimensions (width x height x length)	300 x 246 x 2400	mm
Weight	310	kg
Permissible axle loads	32	Ton
Maximum speed	250	Km/h
Concrete grade	50/60	

GR 220 W	VALUE	UNIT
Dimensions (width x height x length)	300 x 267 x 2300	mm
Weight	298.5	kg
Permissible axle loads	30	Ton
Maximum speed	300	Km/h
Concrete grade	50/60	

GR 190 W	VALUE	UNIT
Dimensions (width x height x length)	300 x 264 x 1900	mm
Weight	273	kg
Permissible axle loads	25	Ton
Maximum speed	300	Km/h
Concrete grade	50/60	

GR 870	VALUE	UNIT
Dimensions (width x height x length)	300 x 230 x 2400	mm
Weight	300	kg
Permissible axle loads	32	Ton
Maximum speed	300	Km/h
Concrete grade	50/60	

GR 870 CH	VALUE	UNIT
Dimensions (width x height x length)	300 x 213 x 2400	mm
Weight	280	kg
Permissible axle loads	25	Ton
Maximum speed	250	Km/h
Concrete grade	50/60	

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Advantages of Greenrail Technology

The "Greenrail" Project aims at introducing to the market its innovative and disruptive railway sleepers, whose features include versatility, innovation and eco-sustainability.

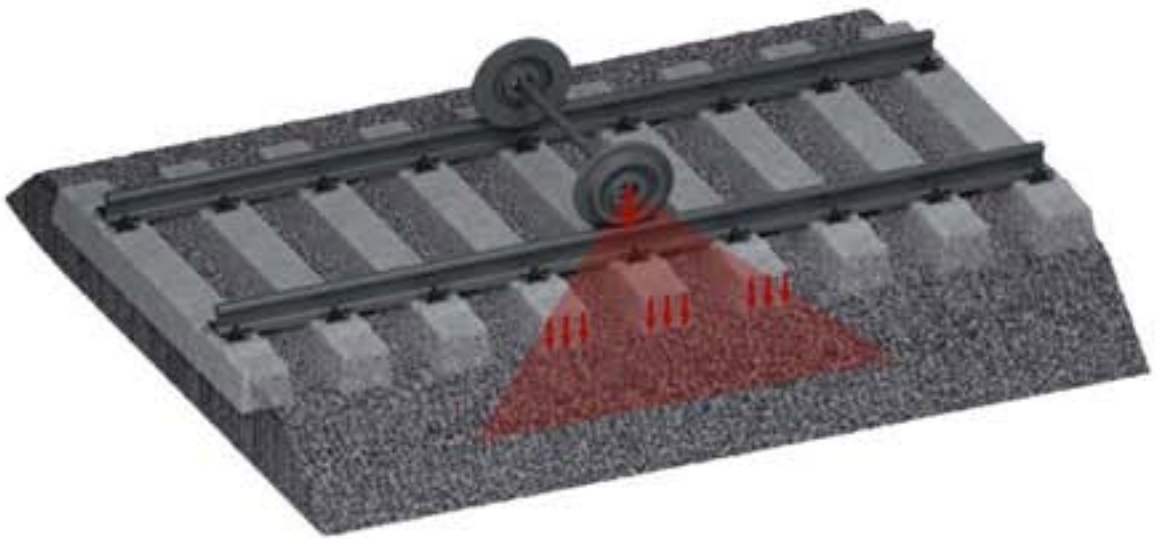
Greenrail system, compared to concrete sleepers, has numerous technical advantages reducing the maintenance costs of railway lines:

- less ballast pulverization;
- less lateral displacement;
- better electrical insulation;
- increase of the contact area;
- possible reduction of the ballast thickness;
- reduction of vibration and noise;
- positive environmental impact reducing vibration, noise and pollution from ballast pulverization.

These advantages are possible through improvements in the following aspects:

1 Sleeper collaboration discharging the load;
2 Distribution of the vertical load;
3 Reduction of hollow areas;
4 Distribution of the horizontal load.

CONCRETE SLEEPERS



GREENRAIL™ SLEEPERS

A LESS RIGID SYSTEM PERMITS TO DIVIDE THE LOAD IN MORE SLEEPERS.
THE EFFECT IS A REDUCTION OF STRESS IN THE BALLAST BED.

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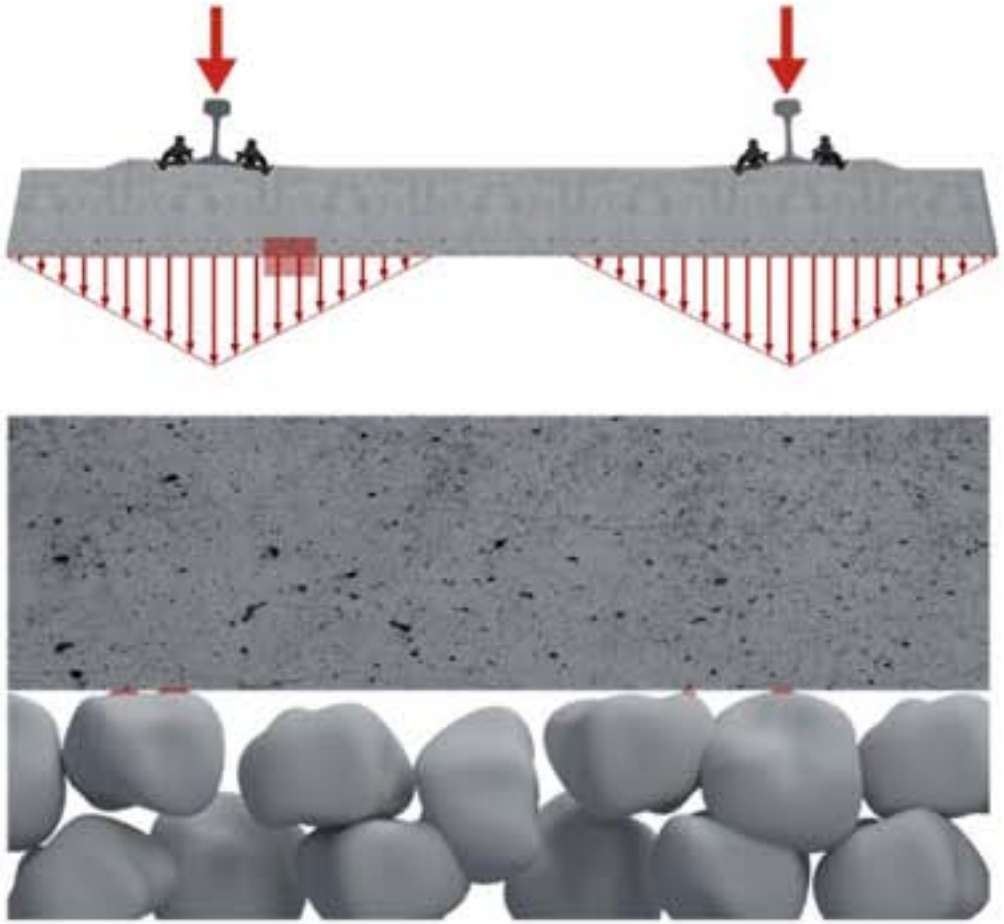
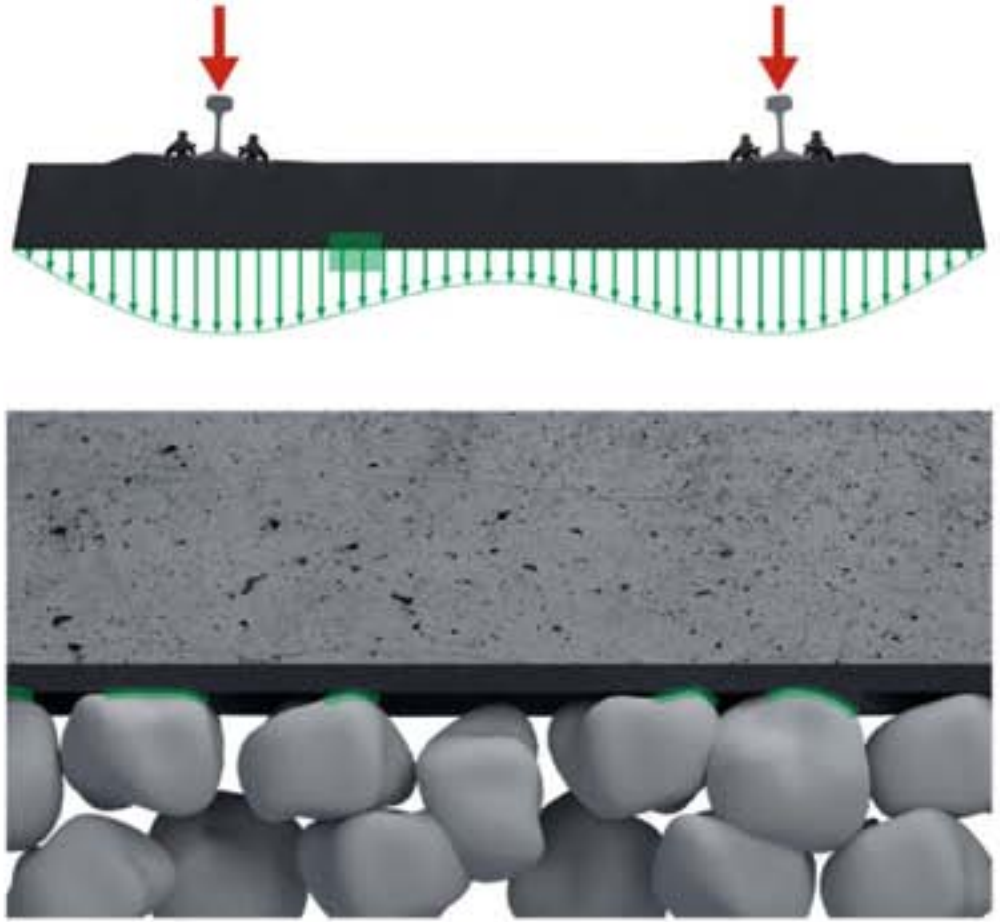
2. Distribution of the vertical load

An increase of the contact area leads to a
better load distribution in order to reduce the peak load value



Detail of section
Contact ballast/concrete sleeper



Detail of section
Contact ballast/Greenrail sleeper

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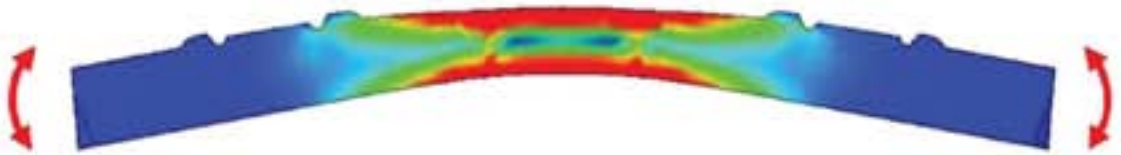
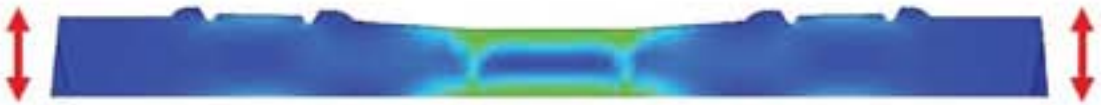
3. Reduction of hollow areas

Detail of hollow areas



Concrete sleeper deflection and inner stress



Greenrail sleeper

Over time hollow areas appear below the sleeper.

Adding an elastic layer avoids a hard interface with the ballast, allowing the stones to bed into the compound.

Greenrail technology increases the surface area and avoids excessive contact forces, leading to a better stability, less settlement and reduced wear of the track components.

A reduction of hollow area formation is permitted by the Outer shell thanks to the lowering of deflection.

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4. Distribution of horizontal load

Even in the side surface
increases the contact area

A net on the bottom surface
allows a better ballast insertion

Detail of bottom surface

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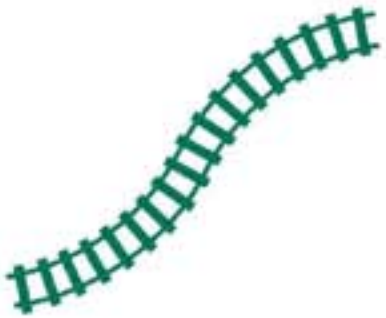
OTHER ADVANTAGES



IMPROVEMENTS IN TRACK STABILITY

A BETTER LATERAL RESISTANCE GUARANTEES, FOR A LONGER TIME, THE CORRECT GEOMETRY OF THE TRACK

INCREASE OF THE TRACK ELASTICITY

ELASTICITY BETWEEN SLEEPERS AND BALLAST THROUGH AN ELASTOMERIC MATERIAL

ELECTRICAL INSULATION

THE OUTER SHELL GUARANTEES THE ELECTRICAL INSULATION OF THE SLEEPER PREVENTING THE CONCRETE FROM DISPERSED ELECTRICITY

REDUCTION OF VIBRATION AND NOISE

THE DECREASE OF STIFFNESS IN THE CONTACT AREA LEADS TO AN ABATEMENT OF VIBRATION AND NOISE

LESS MAINTENANCE COSTS

2 TO 2.5 TIMES LONGER PERIODS BETWEEN TAMPING AND RENEWAL OPERATION

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USE OF ELTS AND RECYCLED PLASTIC

IN GREENRAIL'S STRATEGY, THE INNOVATION THROUGH ECO-SUSTAINABILITY AND SLEEPERS DEVELOPMENT IS THE KEY TO RENOVATING THE SECTOR.
THIS APPROACH MAKES GREENRAIL TECHNOLOGY UNIQUE: IT DOES NOT ONLY IMPROVE THE SLEEPERS TECHNICAL FEATURES, BUT IT ALSO ALLOWS TO HANDLE THE ISSUES RELATED TO THE WASTE MANAGEMENT, SUCH AS TYRES AND PLASTICS.
GREENRAIL CONTRIBUTES TO MANAGE THE URBAN WASTE SUCH AS RUBBER USING IT AS ONE OF THE COMPONENTS OF THE OUTER SHELL.

THE BENEFITS RELATED TO THE USE OF ELTS AND RECYCLED PLASTIC ARE:

- EVERY KM (1670 SLEEPERS) DISPOSES UP TO **35 TONS** OF RECYCLED MATERIAL;
- HIGH ELASTIC AND **LONG TERM RESISTANCE**;
- ELECTRICAL INSULATION.

THE GREENRAIL OUTER SHELL, AT THE END OF LIFE, CAN BE RECYCLED FITTING A CIRCULAR ECONOMY PROCESS

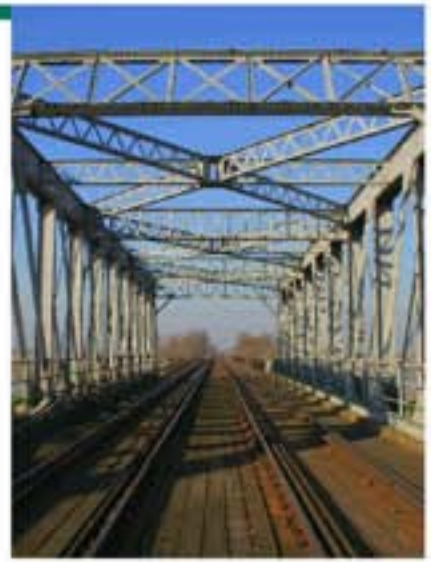
GREENRAIL™

APPLICATIONS

COVENTIONAL RAILWAY LINES

HIGH SPEED RAILWAY LINES

ON BRIDGES, AND ON THE APPROACH TO, AND RUNNING OFF BRIDGES



IN TRANSITION AREAS AND IN BALLASTLESS TRACK

CRITICAL ZONES SUCH AS AN EXISTING TUNNEL, BRIDGE OR UNDERPASS WHERE A REDUCTION OF THE BALLAST THICKNESS IS NEEDED

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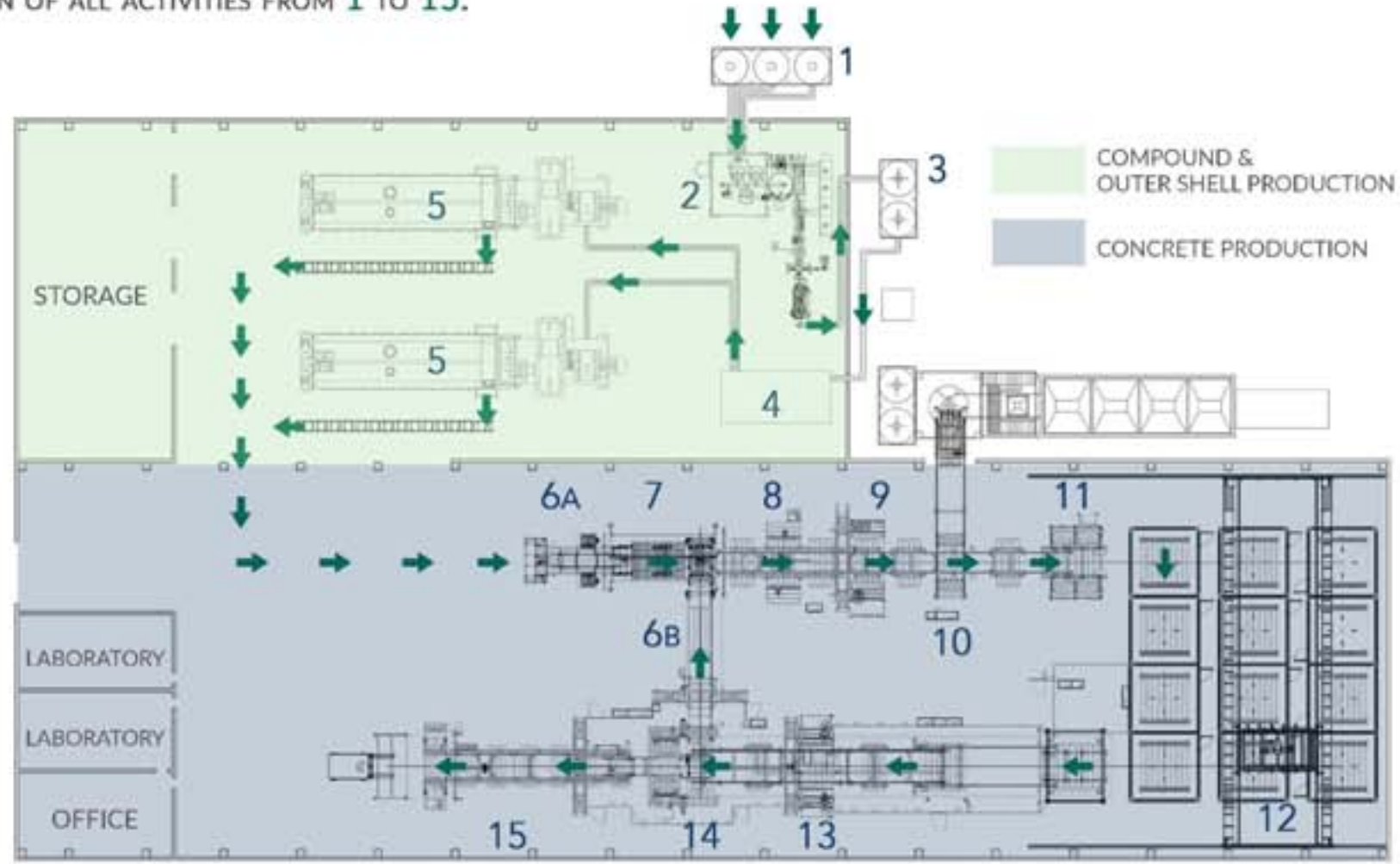
FACTORY LAYOUT

CONCRETE CASTING IS DONE DIRECTLY IN THE OUTER SHELL.
GREENRAIL PRODUCTION CONSISTS OF **COMPOUND EXTRUSION, OUTER SHELL MOLDING AND CONCRETE CASTING.**
THE FIRST TWO PHASES CON BE DONE IN **OUTSOURCING** TO REDUCE INITIAL INVESTMENT COSTS.
GREENRAIL IS ABLE TO FOLLOW THE DESIGN OF ALL ACTIVITIES FROM **1** TO **15**.

1_STORAGE OF RAW MATERIALS;
2_EXTRUSION OF THE COMPOUND;
3_COMPOUND STORAGE;
4_DRYING MATERIAL;
5_FILLING THE MOULD WITH THE INJECTION MOLDING MACHINERY;
6A_STEEL REINFORCEMENT PREPARATION;
6B_LUBRIFICATION OF THE FORMWORK;
7_POSITIONING OF THE STEEL REINFORCEMENT;
8_FORMWORK PREPARATION;
9_STEEL PRETENTIONING;
10_CONCRETE CASTING;
11_BOTTOM SIDE POSITIONING;
12_HARDENING CONCRETE BY MATURATION CELLS;
13_FORMWORK UNSCREWING;
14_FORMWORK EMPTYING;
15_FASTENING SYSTEMS AND LATERAL PLUGS ASSEMBLING.



GREENRAIL SOLAR

SOLAR PANELS INTEGRATED IN THE OUTER SHELL TO CREATE A PHOTOVOLTAIC FIELD ON THE RAILWAY LINE

GREENRAIL LINKBOX

A PHOTOVOLTAIC PANEL INTEGRATED IN THE OUTER SHELL PROVIDES ENERGY FOR COMUNICATION AND DIAGNOSTIC SYSTEMS