

SSAB Steel piles



General



SSAB is one of the leading suppliers of steel foundation structures in Europe. Our main markets are the Nordic countries and the Baltic sea region, but thanks to our efficient logistics we are also able to deliver solutions for demanding applications elsewhere in Europe. SSAB is your competent partner. Our solutions are economically competitive and technically first rate. They are based on our comprehensive know-how and responsible mode of operation. To us, partnership with the customer includes commitment to quick and prompt delivery and consultation during the design and execution stages, if necessary. Our operations combine expertise in steel and foundation structures. The RR®

and RD® piles are a reliable and high quality steel piles manufactured by SSAB installed by driving or drilling method. The easy-to-use splicing method developed for small diameter RR and RD piles that meets the highest requirements set for mechanical pile splices is a good way to improve the productivity of piling work and the quality of foundation structures. A large diameter RR and RD pile is the right choice when the pile is subject to high loads and high reliability is required.



SSAB offers an extensive selection of pile sizes and steel grades from RR75-RR/RD320 small diameter piles to RR/RD400-RR/RD1200 large diameter piles.

The RR and RD pile manufactured by SSAB is a registered trade mark. SSAB have CE marking, based on European Technical Assessment (ETA 12/0526), which is the most comprehensive CE marking to be granted to pile structures made of structural steel. It covers the entire pile structure, manifests the requirements and conformity of the mechanical splices, and establishes that the product has been manufactured specifically for piling. The

approval is based on detailed load tests, especially on splices, continuous quality control during the various phases of production, and traceability of materials. Use of SSAB CE marked piles in a construction project ensures the durability and performance of foundations. Tested products guarantee problem-free site installation.

Applications of RR[®] and RD[®] piles



Construction of detached houses

The small diameter RR and RD piles offer an effective and convenient way to implement the piling of a detached house. The easy-to-use and cost-efficient splicing method allows quick installation of RR and RD piles with minimal material waste. The steel piles can be installed with light equipment, which considerably reduces the need for and costs of earthworks. Owing to their many technical and economic advantages, RR and RD piles are the most popular method on the market for implementing pile foundations of detached houses.

Construction of blocks of flats and office and industrial buildings

The use of steel piles in the construction of blocks of flats and office and industrial premises has increased rapidly especially in difficult soil conditions and with structures subject to high concentrated loads. Thanks to their high load-bearing capacity and extensive size range, the number of RR and RD piles can be optimised effectively. With RR piles soil displacements and vibration from the installation of driven piles can be minimised.

Underpinning of foundations

RR piles are highly suited for use in underpinning of foundations because the rapid and reliable mechanical pile splices allow selecting pile length on the basis of the requirements of the installation site and equipment. Under restricted access and headroom conditions piles exceeding 50 metres in length have been implemented using RR pile elements 1.0 to 1.5 metres long.

Harbour construction

Harbour construction is one of the main and most traditional applications of large diameter RR and RD piles. Many quays and piers of the most important Baltic Sea harbours have been

founded on RR and RD piles due to their excellent load-bearing capacity, bending stiffness and bending resistance. Combi-walls, composed of steel piles and sheet piles, have become the most common structural solution for quays as their modifiability allows wide-ranging optimisation of the capacity and shape of a structure.

The piles used in harbour construction are usually long, and SSAB has extensive experience from their supply and logistics management.

Construction of bridges and transport infrastructure

Use of RR and RD piles in the construction of bridges allows making the pile foundation an integral part of the overall bridge structure and its performance. In small bridges extra intermediate structures may be eliminated when steel piles are connected directly to the deck without bearings. The shorter construction time and effective structural solutions are made use of, for example, in demountable railway bridges. In the case of slabs on piles, the high loadbearing capacity of the RR piles in relation to their cross-sectional area is a marked advantage, as the amount of soil displaced by driven RR piles is about a fourth of that required by conventional piling solutions.

RR and RD piles can be used in many ways in the foundations of different noise barriers. For example, the most optimal pile size from a wide range can be selected for a monopile foundation. Attachment of the frame structures of noise barriers to steel pile foundations is also easy.

Advantages of the driven RR piles:

- Less displacement and disturbance of soil in relation to the load-bearing capacity of the pile.
- Reduced vibration in relation to the load-bearing capacity of the pile.
- Ability to use lighter installation equipment.
- Easy to use and cost efficient.



- Quick installation with minimal material waste.
- Considerably reduces the need for and costs of earthworks.
- Soil displacements and vibration from the installation of driven piles can be minimised.
- Thanks to high load-bearing capacity and extensive size range, the number of piles can be optimised effectively.
- Pile length can be selected on the basis of the requirements of the installation site and equipment.

Drilled piles are suitable for use in demanding applications when:

- The soil contains obstacles in the soil that are difficult to penetrate such as stones, boulders or old foundation structures.
- The aim is to ensure that piles bear securely on bedrock, as in the case of piles subject to compressive or tensile loads designed to be bear on bedrock.
- The bedrock slants and piles need to be prevented from sliding by drilling them into bedrock.
- The bedrock lies close to ground surface and requires rigid installation of piles by drilling them into bedrock to provide a stable foundation.

- The foundation is subject to high concentrated loads in soil conditions that require a pile foundation, where the use of conventional piles would require a great number of piles and a large footing.
- The foundation is subject to high concentrated loads in frictional soil areas where a conventional groundsupported spread foundation requires a large footing and a lot of earthwork.
- Piling work takes place near existing buildings or structures and there are strict requirements for the environmental impacts of the piling, such as vibration, soil settlement and displacements.
- Piling takes place under restricted access and headroom conditions.

Pile accessories

Pile pipes and elements

Small diameter RR and RD piles

Small diameter RR and RD piles are based on high quality longitudinally welded steel pipes. RR75-RR270 piles are delivered as pile elements equipped with mechanical splices or as pile pipes without splices. RD90-RD320 piles are delivered as pile elements equipped with mechanical splices or as pile pipes without splices. RR320 piles are delivered as pile pipes.

The standard lengths of the pile elements and the sectional properties of the piles, see SSAB's design and installation manual for steel piles.

Steel grades

Steel grades specially manufactured by SSAB for piling applications are used for RR and RD piles. The steel grade of the RR and RD piles is S460MH and that of the RRs and RDs piles S550J2H. The selection of the steel grade affects significantly the structural resistance of the pile. Pile diameter or wall thickness may in many cases be reduced or the total number of piles decreased by selecting a higher steel grade.

Production tolerances of piles and splices

The production tolerances of the steel pipes used for SSAB piles and splices are significantly stricter than those for common structural pipes. Strict production tolerances ensure the performance of the splices. Normal production tolerances for structural pipes do not meet the requirements set for mechanical pile splices, and structural pipes may not be used with mechanical pile splices.

Mechanical pile splices

RR piles utilise high quality friction splices that meet the requirements for rigid splices set in Finland's NA for EN 1993-5 and Finnish Piling manual PO-2016. The easy-to-use external double conical sleeve can be used from pile size RR75 up to pile size RR/RRs270/12.5.

RD piles come with threaded sleeves that meet the requirements for rigid splices of Finland's NA for EN 1993-5 and Finnish piling manual PO-2016. Threaded sleeves can be used with pile sizes from RD90 to RD/RDs320. Mechanical splices are reliable and effective, requiring no splice welding on site. When mechanical splices are not used, piles are spliced by welding.



Identification of piles

SSAB's RR and RD piles are identified by the marking on their side. Identification tape is also attached to RR pile elements on or near the splice. Pile bundles are delivered with product descriptions that indicate, besides pile manufacturer and dimensions, the steel grade of the RR and RD piles.

Pile shoes

Pile shoes attach to RR75-RR320 piles by friction. The dowel of the rock shoe is made of tempered special steel that ensures good penetration into rock.

Bearing plates

Usually a bearing plate is installed at the top of the RR and RD piles to transfer the loads of the superstructure to the pile. The bearing plate is centered on the pile top by an internal sleeve, which serves to keep the bearing plate in place.



Installation of RR and RD pile

RR piles can be easily extended by mechanical splices. If an external splice is used, the driving of the pile is usually started at with an unspliced pile section without a splice, using, for example, a leftover piece of an earlier cut pile with a pile shoe attached to the cut end. When the first pipe has been driven into the ground, the pile is spliced by installing the next element on top of it one with the splicing sleeve at the bottom, and driving is continued. A sufficient number of new elements are added to make the pile tip reach the target level specified in the design or bear on bedrock or a compact soil layer so that the end-of-driving criteria are met.

Small diameter RD piles can be installed with considerably lighter equipment than conventional piles of equal compressive strength. This is a major advantage when conditions are difficult for big installation equipment or the installation space is confined. Moreover, the installation of RD piles causes only a little vibration in the environment. Using threaded sleeves facilitates making reliable splices even in demanding site conditions without welding. It eliminates the need for a qualified welder during installation. Moreover, natural conditions are not a challenge to the implementation of a perfect splice, either. The time needed for splicing is also considerably shorter than with welding. Other advantages of the threaded sleeve are high fatigue strength and tensile strength of the splice.

Large diameter RR and RD piles

Piles

Large diameter RR and RD piles are based on spirally welded high quality steel pipes. The pile range covers sizes 400 to 1200 mm. Large diameter RR and RD piles can also be made in other diameters and customerspecific wall thicknesses specified to within 0.1 mm. For more detailed sectional properties of the piles see SSAB's design and installation manual for RR® and RD® piles.

Steel grades

Standard steel grade S355J2H and steel grades S440J2H and S550J2H specially manufactured by SSAB for piling applications are used for large diameter RR and RD piles. Against special order, the piles may also be delivered in MH steel grades according to standard EN 10219.

Identification of piles

SSAB's RR and RD large diameter piles are identified by a marking on the side. In addition, piles are equipped with product descriptions that indicate, besides pile manufacturer and dimensions, the steel grade of the RR and RD piles.

Splicing of piles

Up to 39 m long large diameter RR and RD piles without splice welds can be manufactured to order. The longest RR piles with welded splices delivered by SSAB have been 45 m long. Piles cut to size according to the customer's specification help minimise splice welding on site and bring considerable savings in construction costs and time. If necessary, RR and RD piles can be spliced by welding on site.

Pile shoes

In the Nordic countries, end-bearing RR piles are usually equipped with RR rock shoes. Structural calculations for the shoes are based on accurate FEM analyses, and the Finnish Transport Infrastructure Agency and Swedish Trafikverket have given permission for their use.

Rock shoes are used to protect the lower end of the pile against excess stresses during installation, to center the stresses on the pile tip as evenly as possible across the pile cross-section, and to prevent lateral sliding of the pile tip.

Pile accessories

Large diameter RR and RD piles can be delivered individually according to the customer's designs. The piles can be equipped, for instance, with connectors. Connectors are welded simultaneously to both sides of a pile in an automated production line, which makes for efficient production and ensures high quality of the end product.

SSAB also delivers RR piles and products based on them with a protective paint or HDPE 3-layer coating.

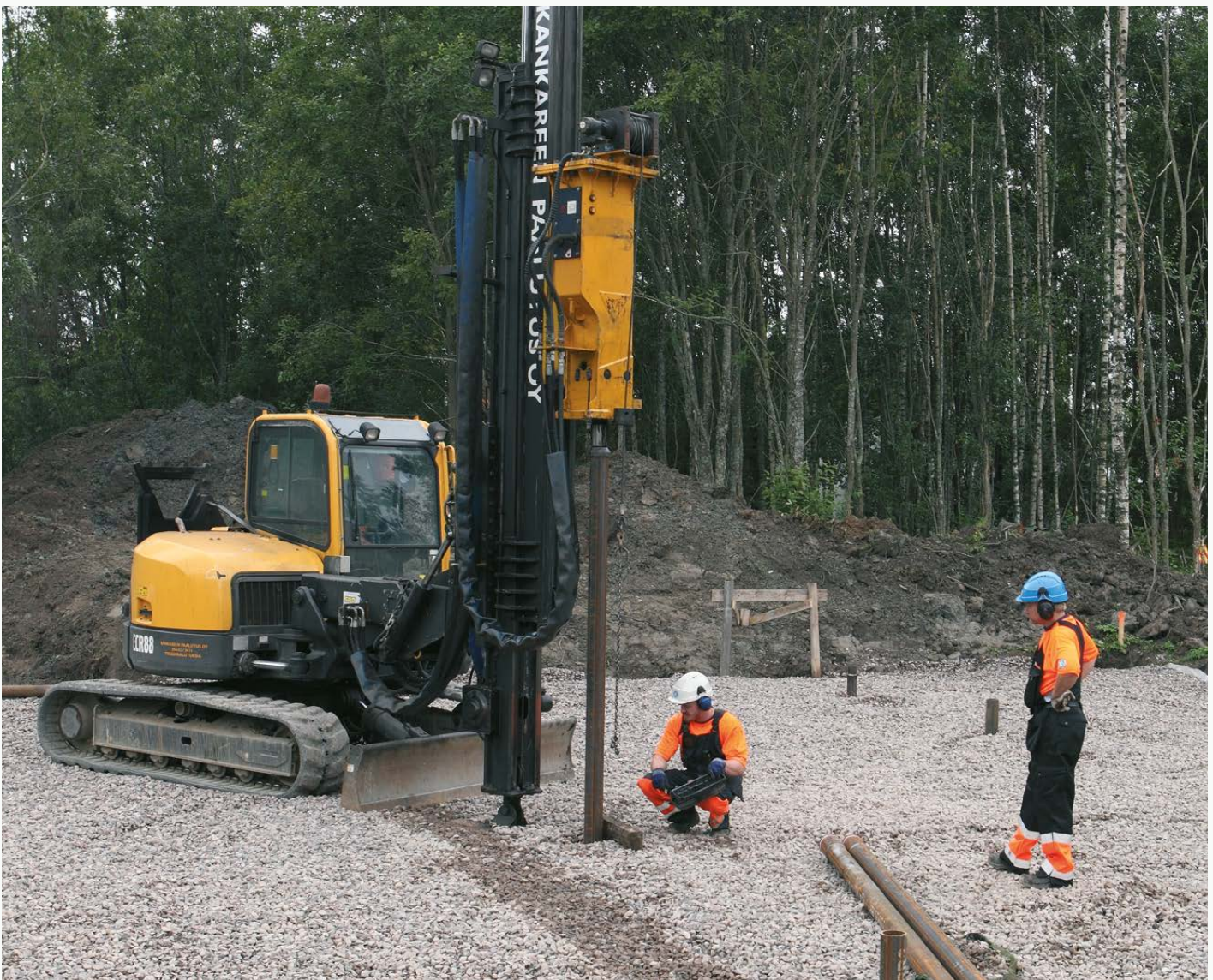
If necessary, casing shoes delivered or specified by the customer can be welded onto large diameter RD piles. SSAB does not manufacture the ring and pilot bits used in installation.



Steel grades

Table 1. Standard steel grades for SSAB steel piles

Steel grade	Carbon equivalent	Chemical composition, max.				Mechanical properties				
		CEV max. [%]	C [%]	Mn [%]	P [%]	S [%]	f_y min [MPa]	f_u [MPa]	A_5 min [%]	T [°C]
S355J2H	0.45	0.22	1.6	0.03	0.03	355	470-630	20	-20	27
S440J2H	0.45	0.16	1.6	0.02	0.02	440	490-630	17	-20	27
S460MH	0.46	0.16	1.7	0.035	0.03	460	530-720	17	-20	40
S550J2H	0.47	0.12	1.9	0.02	0.02	550	605-760	14	-20	27



Pile sizes and steel grades

Table 2. Pile sizes and steel grades for driven RR piles

Pile	Diameter [mm]	Wall thickness [mm]										
		6.3	8	10	12.5	14.2	16	18	20	21	22	23
RR75	76.1											
RR90	88.9											
RR/RRs115	114.3											
RRs125	127.0											
RR/RRs140	139.7											
RR/RRs170	168.3											
RR/RRs220	219.1											
RR/RRs245	244.7											
RR/RRs270	273.0											
RR320	323.9											
RR400	406.4											
RR450	457.0											
RR500	508.0											
RR550	559.0											
RR600	610.0											
RR650	660.0											
RR700	711.0											
RR750	762.0											
RR800	813.0											
RR900	914.0											
RR1000	1016.0											
RR1200	1220.0											

- Steel grade S460MH
- Steel grade S550J2H
- Steel grades S460MH and S550J2H
- Steel grades S355J2H, S460MH and S550J2H
- Steel grades S355J2H, S440J2H and S550J2H
- Steel grades S355J2H and S440J2H
- Check availability from SSAB sales

Table 3. Pile sizes and steel grades for drilled RD piles

Pile	Diameter [mm]	Wall thickness [mm]										
		6.3	8	10	12.5	14.2	16	18	20	21	22	23
RD90	88.9											
RD/RDs115	114.3											
RD/RDs140	139.7											
RD/RDs170	168.3											
RD/RDs220	219.1											
RD/RDs270	273.0											
RD/RDs320	323.9											
RD400	406.4											
RD450	450.0											
RD500	508.0											
RD550	559.0											
RD600	610.0											
RD650	660.0											
RD700	711.0											
RD750	762.0											
RD800	813.0											
RD900	914.0											
RD1000	1016.0											
RD1200	1220.0											

- Steel grade S460MH
- Steel grades S460MH and S550J2H
- Steel grades S355J2H, S460MH and S550J2H
- Steel grades S355J2H, S440J2H and S550J2H
- Steel grades S355J2H and S440J2H
- Check availability from SSAB sales

Environment

4

The splicing method of RR piles allows high pile material utilisation. A section cut off a pile can be made part of the next pile to avoid the problem presented by leftover lengths of piling.

The splicing method of RR and RD piles makes splicing considerably faster. Thereby the productivity of work increases and less inconvenience is caused to those living and working in the vicinity of the site.

3

The mechanical splices of SSAB piles are designed to allow using the entire cross-sectional capacity of the pile in the dimensioning of the pile. SSAB splices are tested and functionally reliable.

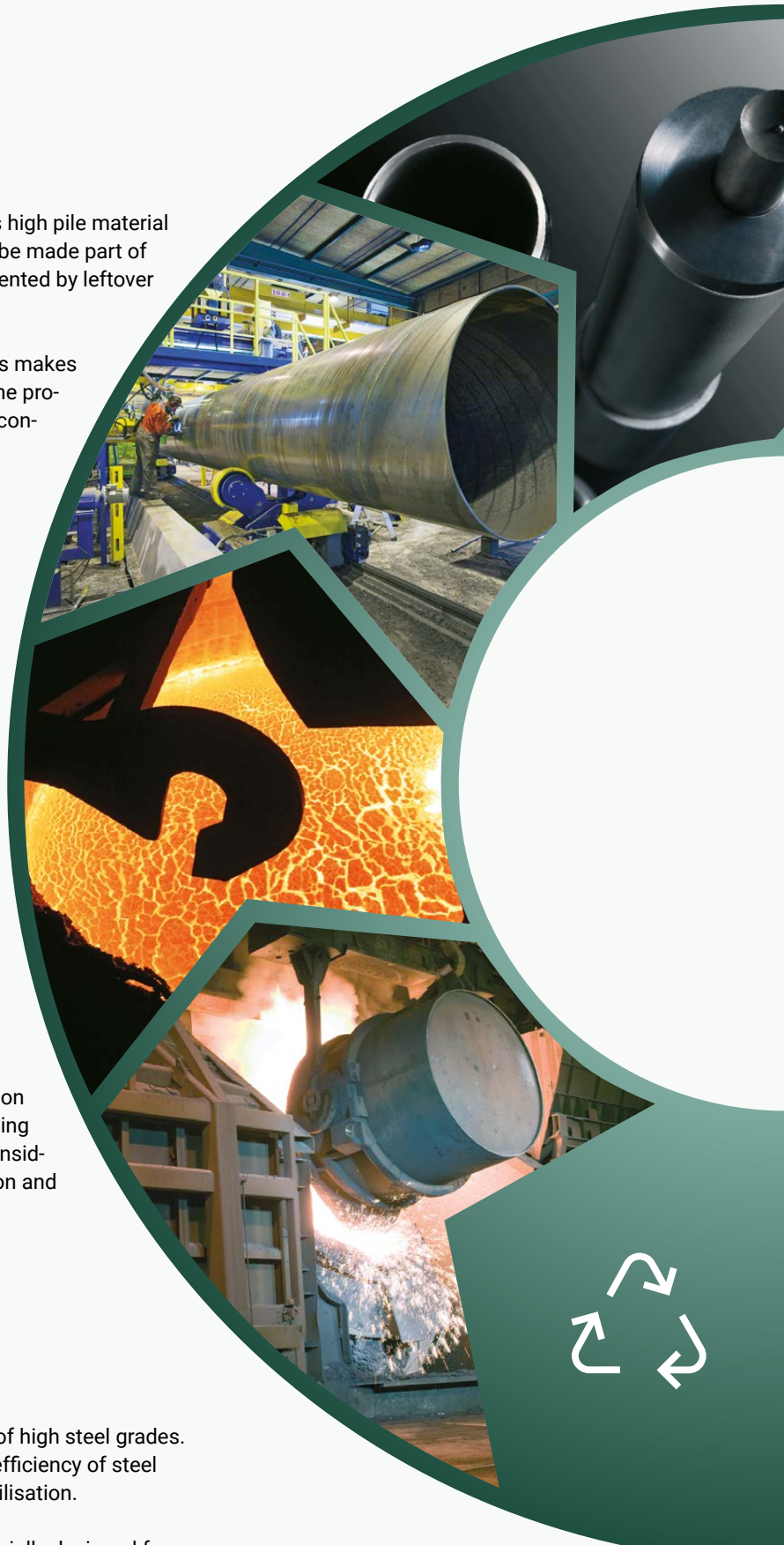
2

Steel is a very durable material in relation to its weight. The transportation, handling and installation of RR piles requires considerably less energy than other foundation and ground improvement solutions.

1

SSAB is a pioneer in the development of high steel grades. The development aims at ever higher efficiency of steel structures and higher steel capacity utilisation.

The steel grade used for RRs piles specially designed for piling allows savings of up to 25 to 40% in the material needed for piling compared to conventional steel grades.





The RD pile wall is a new innovative way to implement foundations of buildings with a basement or other watertight structures quickly and cost-effectively.

It reduces the work phases required by conventional construction, the amount of energy consumed and disturbance to the environment.

5

Steel piles can also be installed with light equipment, the installation causes little vibration, and soil displacement is clearly smaller than with conventional pile products. RD pile installation causes only little vibration, and replacement piles do not displace soil.

6

RR and RD piles can easily be used as energy piles. In the energy pile solution, geothermal heat collecting pipes are inserted in the pile, whereby the pile functions as part of the building's heating and cooling system. Energy piles provide considerable added value to the steel pile foundations and improve the environmental efficiency of steel piles even further.

Steel is the most recycled material in the world. A final product made of steel is 100% recyclable.

7

Production and quality control



SSAB follows in its operations procedures that comply with the requirements of ISO 9001 quality management system and ISO 14001 environmental management system. Quality management systems ensure the functioning of processes from raw materials procurement to delivery of the end product to the customer. SSAB RR and RD steel piles are made of the high quality steel produced at the company's own steel works.

The manufacture of RR and RD piles and accessories is based on modern automated production technology that ensures the high quality of the products.

For instance, the manufacture of rock shoes for large diameter RR piles and their welding onto piles under workshop conditions using precise preheating of components and robotic



welding equipment ensure the durability of weld seams and high and even quality of the end product.

The technical delivery conditions of the piles conform to standard EN 10219-1. Dimensions and tolerances are according to standard EN 10219-2. A material certificate of type 3.1 specified in EN 10204 is supplied with the pile material.

SSAB is a Nordic and US-based steel company that builds a stronger, lighter and more sustainable world through value added steel products and services. Working with our partners, SSAB has developed SSAB Fossil-free™ steel and plans to reinvent the value chain from the mine to the end customer, largely eliminating carbon dioxide emissions from our own operations. SSAB Zero™, a largely carbon emission-free steel based on recycled steel, further strengthens SSAB's leadership position and our comprehensive, sustainable offering independent of the raw material. SSAB has employees in over 50 countries and production facilities in Sweden, Finland and the US. SSAB is listed on Nasdaq Stockholm and has a secondary listing on Nasdaq Helsinki. Join us on our journey!

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The SSAB logo consists of the letters 'SSAB' in a bold, dark blue, sans-serif font. The letter 'S' is the largest and most prominent, followed by another 'S', then 'A', and finally 'B'. The letters are closely spaced and have a slight shadow effect, giving them a three-dimensional appearance.