



## CASE STUDY

**CLIENT NAME**  
SWEDISH TRANSPORT  
ADMINISTRATION

**MAIN CONTRACTOR NAME**  
TERRAGRIP

**CONSULTANT**  
MINOVA WELDGRIP (UK)

**PRODUCT USED**  
PARARIB™

**GRADES USED**  
100/100

**AVAILABLE GRADES**  
30kN/12kN, 30kN/30kN,  
80kN/80kN, 100kN/100kN,  
160kN/60kN and 200kN/100kN.  
Custom grades are available upon  
request.

**PROJECT LOCATION**  
STOCKHOLM SWEDEN

**PROJECT COMPLETION**  
2017

**Linear**  
COMPOSITES

## STOCKHOLM CITY LINE

### STOCKHOLM | SWEDEN



PARARIB™ reinforced metro station

### PROJECT

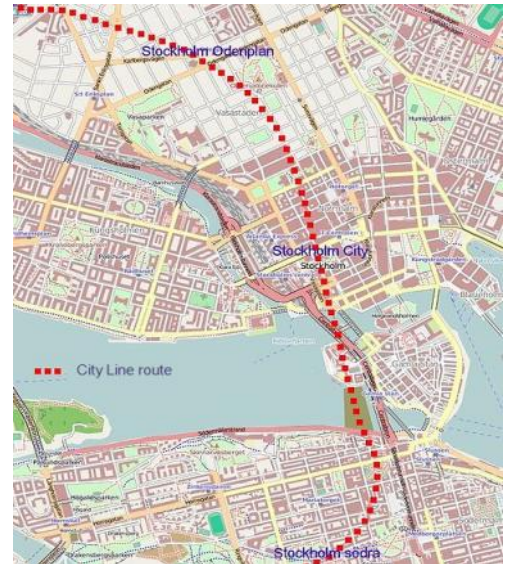
Nationally 80% of commuter trains use Stockholm as their start or end location. On a daily basis this equates to approximately 550 trains. This presents a serious problem as all of this traffic operates over only two tracks, which were first established in 1871. High occupancy and low capacity have only one outcome, congestion and delays which affect the entire rail network.

To ease congestion and increase capacity a radical solution was proposed: to link Tomtebodan and Stockholm South stations with a 6 km long tunnel passing directly under the city. The City Line was originally proposed in 1988 and finally received approval in 2006.

Upon completion all commuter trains will run along the City Line, freeing up the present tracks. This will double the rail capacity of the city and allow commuter trains to run on time.



PARARIB™ tunnel containment system



City Line Route

### PROBLEM

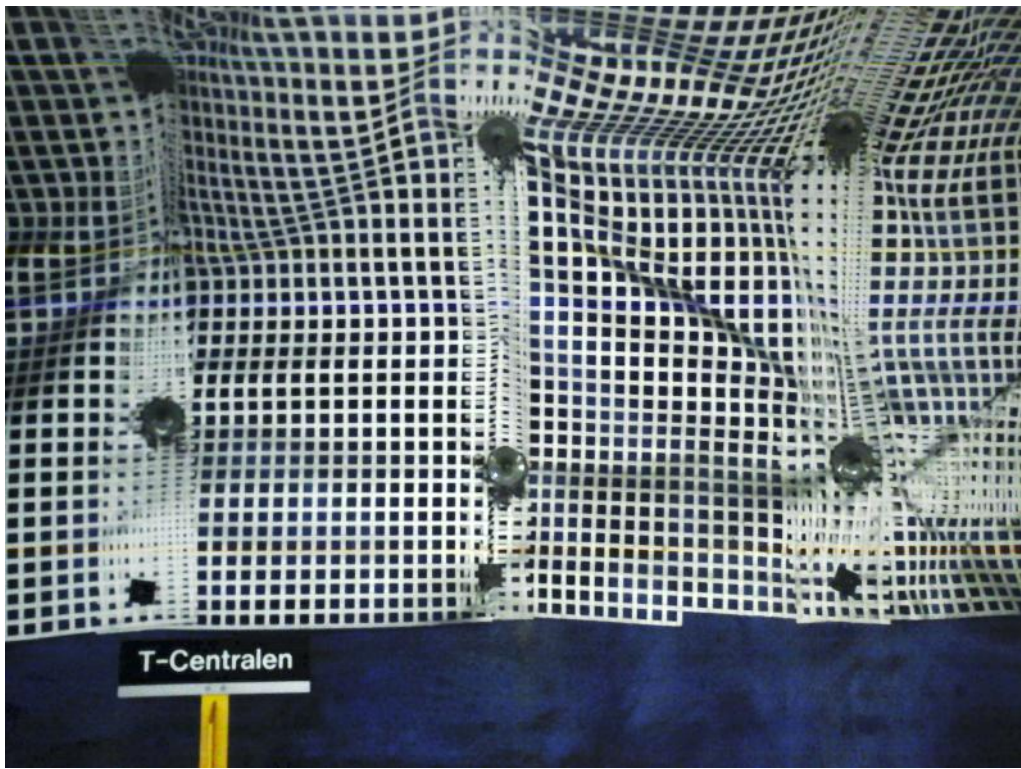
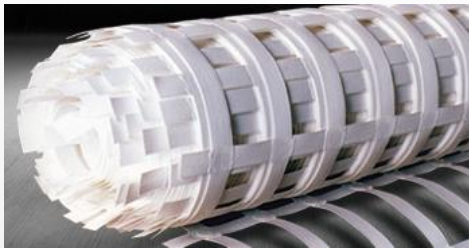
The City Line will pass directly below two subway lines within the T-Centralen subway station. Due to the close proximity of the two tunnel networks there was a risk that vibrations generated during tunneling operations would weaken tunnel walls and ceilings and allow rocks to fall. Such debris could cause fatal injury to people and damage valuable machinery.

### SOLUTION

The solution was to reinforce the tunnel walls and ceilings with a containment system. This system would arrest falling debris and prevent damage or injury. Key requirements for the containment systems reinforcement material included high tensile strength, high modulus, low weight, low gaseous emissions alongside flame retardant properties. Upon consideration design engineers selected PARARIB™ as the reinforcement material.



## CASE STUDY



PARARIB™ tunnel containment system within T-Centralen subway station.

PARARIB™ is a two dimensional mining mesh which is constructed from high strength synthetic webbing; consisting of discrete bundles of high tenacity polyester coated in a polyolefin sheath. PARARIB™ is specifically designed to be used in tunnel lining applications.

When working in underground environments flame retardant properties and low gaseous emissions are pre requisites. All PARARIB™ products have a specially formulated co-polymer sheath which is flame retardant to ISO 9705:1993, whilst also exhibiting excellent gaseous emissive properties; compliant to BS 6853:1999 (tested to NFX 70-100: 2006). Other key properties include high tensile strength and low elongation at break. It is also easily visible in areas of low illumination and highly flexible allowing easy installation.

PARARIB™ is available in strengths ranging from 30kN/m / 12kN/m to 200kN/m / 100kN/m and can be made in lengths and widths to meet customer requirements. Due to its excellent creep characteristics PARARIB™ is suitable for applications where long design life is critical.

The type of PARARIB™ specified for this application was 100kN/m / 100kN/m, this is a mid strength, biaxial mining grid.

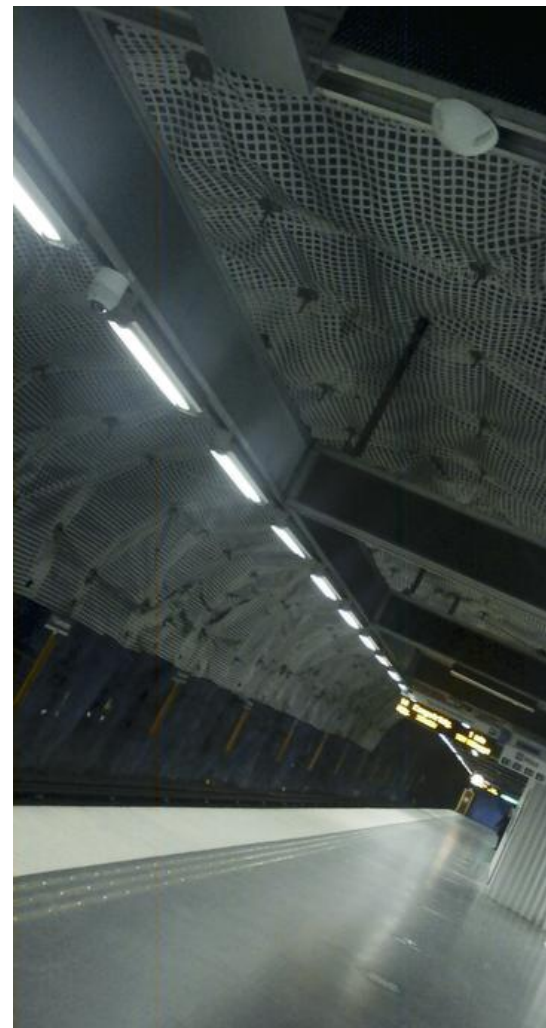
The tunnel containment system was constructed by securing PARARIB™ to the tunnel walls and ceilings via roof bolts. Once installed the system acts to arrest falling debris, preventing damage to vehicles or injury to pedestrians within the subway station.

First installed within the T-Centralen subway station in 2009, the PARARIB™ containment system will remain in place until all blasting for the section of the City Line passing beneath the station is completed.

A Member of the Maccaferri Group



Linear Composites Ltd reserves the right to amend product specifications without notice and specifiers are requested to check as to the validity of the specifications they are using.



T-Centralen subway station

**Linear**  
COMPOSITES

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