

# Comparison of Seismic Retrofit Method for Bridge Piers

	Steel Plate Jacketing Method	Reinforced Concrete Jacketing Method	Carbon Fiber Sheet Jacketing Method	MAGNELINE® PP Method
CROSS SECTION				
STRUCTURAL	<ul style="list-style-type: none"> <li>○ A jacketing method by wrapping steel plates around existing piers and securing them with anchor bars</li> <li>○ Improves fracture toughness &amp; bending strength by restraining concrete piers with steel plates</li> <li>○ Anchor bars further improves pier strength and also reduce earthquake effects on the foundation</li> <li>○ It is important to have consistent filling of non-shrinkage mortar between steel plates and concrete surface</li> <li>○ Allow a gap in the footing area</li> </ul>	<ul style="list-style-type: none"> <li>○ Jacketing by reinforced concrete to improve its ultimate lateral strength during earthquake</li> <li>○ It is important to integrate jacketing concrete and anchor bars together with existing piers and footings</li> <li>○ Because of the cross-sectional area (10+inch around) increase, the total structural weight increases significantly. Therefore, its effect on the foundation needs to be considered. Footing may need to be enlarged and additional piling may be needed</li> </ul>	<ul style="list-style-type: none"> <li>○ A jacketing method using carbon fiber sheets to improve fracture toughness.</li> <li>○ Since carbon fiber sheets are light weight, there will be no significant weight gain or dimensional changes</li> <li>○ Carbon fiber sheets are soft enough to be cut by cutters to any size.</li> <li>○ For the same reason, special cares are needed to protect carbon fiber sheets from vandalism and accidents.</li> <li>○ To effectively increase the strength of piers, precision work is required.</li> </ul>	<ul style="list-style-type: none"> <li>○ A jacketing method using MagneLine polymer cement mortar with high adhesive strength, fracture toughness and anti-carbonation characteristics, to minimize thickness increase.</li> <li>○ Improves its fracture toughness and strength with minor thickness increase (2").</li> <li>○ With higher adhesive strength, the structure will adhere better to the reinforcement rebar.</li> <li>○ Since it has high adhesive strength with concrete, it binds well with concrete.</li> </ul>
CONSTRUCTION & APPLICATION	<ul style="list-style-type: none"> <li>○ Although quick application is possible since steel plates are produced before hand, highly skilled welders are required and cautions should be paid for warping</li> <li>○ Due to large equipment usage, larger work spaces are required and also limits under-deck applicator</li> <li>○ Thorough surface preparation of existing concrete surface is required. It is important to maintain constant clearance between the plates and the concrete surface</li> </ul>	<ul style="list-style-type: none"> <li>○ Since all the materials have to be prepared at site and forms have to be used for concrete, application will require more time than others.</li> <li>○ To maximize the adherence to existing surface, thorough surface preparation is required.</li> <li>○ Due to large equipment usage, larger work spaces are required and also limits under-deck applicator</li> </ul>	<ul style="list-style-type: none"> <li>○ Handling epoxy adhesive required for carbon fiber sheets, requires skin rash protection.</li> <li>○ It is important to wrap the sheet evenly around. For this surface needs to be prepared to stay even and it is also important to keep any air bubbles out.</li> <li>○ To avoid losing adhesive strength maybe from amino-carbonation, it is very important to maintain the work are completely dry, keeping the moisture away</li> </ul>	<ul style="list-style-type: none"> <li>○ Application time is short since it can be continuously applied with trowel and spray without any form.</li> <li>○ Because of high adhesive strength, less surface preparation is required.</li> <li>○ Since application is continuous, it ensures consistency and it has cosmetically better finish</li> <li>○ Since it is an inorganic water soluble material, it is non-flammable with no danger of explosion</li> </ul>
CAUTIONS	<ul style="list-style-type: none"> <li>○ Anti-corrosion painting of the support plates and periodical repainting are required</li> </ul>	<ul style="list-style-type: none"> <li>○ Structural space limitations or river flow disturbance limitations may restrict the usage of this method</li> <li>○ Surface protection may be required.</li> </ul>	<ul style="list-style-type: none"> <li>○ In order to protect it from UV degradation, it is also important to protect the surface.</li> <li>○ Attention needs to be paid for any water contact</li> </ul>	<ul style="list-style-type: none"> <li>○ MagneLine is anti-corrosive and anti-degradation slow carbonation, high freeze-thaw resistance, and anti-salt, hence, less thickness is required and it also act as protective shield for the concrete</li> </ul>
INSPECTION	<ul style="list-style-type: none"> <li>○ Unable to visually inspect</li> </ul>	<ul style="list-style-type: none"> <li>○ Able to visually inspect</li> </ul>	<ul style="list-style-type: none"> <li>○ Unable to visually inspect</li> </ul>	<ul style="list-style-type: none"> <li>○ Able to visually inspect</li> </ul>

