Union Depot: Assessment of Historic Concrete and Timber Pile Structures

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Summary

Rehabilitation of the historic Union Depot railroad terminal in St. Paul, Minnesota, USA hinged on whether the 90-year-old structure, which exhibited widespread and locally severe deterioration, had sufficient remaining capacity or could be effectively and practically repaired to support the anticipated loads of the rehabilitated facility. The unique approach used to assess the concrete superstructure and timber pile foundations of this very large facility, which relied on comprehensive field inspections followed by targeted testing and structural analysis, allowed most of the original structure to be salvaged and effectively repaired for the desired service life of 50 years.

Keywords: Historic structure, timber piles, wood decay, settlement, load testing, statistical analysis, concrete repair, hydrodemolition, shotcrete, cathodic protection, galvanic anodes, column jackets

1. The Union Depot

The historic Union Depot railroad terminal (Figure 1), constructed circa 1925 along the Mississippi River in St. Paul, Minnesota, USA, was a very active train station through the mid-1960s. In the 1970s, the Depot was converted into a postal distribution center, and most of the railroad tracks, platforms, and ballast were replaced with soil fill and paving. In 2009, Ramsey County Regional Railroad Authority acquired the Depot and embarked on a $130 million rehabilitation of the facility into a multi-modal transportation hub.

Figure 1. Historic photograph of Union Depot, looking north, provided by Ramsey County Historical Society

The Depot's sprawling track deck includes approximately six hundred 21-foot-square bays of reinforced concrete superstructure, with 21-inch thick, reinforced concrete slabs spanning between circular concrete columns and perimeter walls. The columns and walls are, in turn, supported on below-grade concrete pile caps and approximately 9,000 untreated timber piles.

Approximately 90 years of exposure to a harsh northern climate had taken their toll on the track deck superstructure. The concrete elements exhibited advanced deterioration due to leakage, age, and exposure. Loss of timber pile integrity was also suspected because of obvious signs of settlement and structural cracking in several areas of the track deck. Feasibility of the rehabilitation hinged on whether the existing structure had sufficient remaining capacity, or could be effectively and practically repaired, to reliably support the anticipated loads of the rehabilitated Depot.

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of pile degradation, strategically located test pits (Figure 2) and direct examinati
54 piles, field and laboratory load testing of full pile sections (both intact and parti
and innovative statistical analysis to predict future reliability of the timber pile gro

st pit with exposed pile caps and timber piles

It was concluded that the timber pil
foundations supporting the southern
of the track deck should not be relie
to support the heavy rail loads progr
for that portion of the facility.
Underpinning or foundation replace
were recommended for that area. Fo
northern two-thirds of the track dec
the pile conditions were better and t
loads lighter, it was concluded that t
existing foundations should have su
capacity to support the anticipated l
and vehicle loads for the next 50 ye
although there is a relatively low ris
localized foundation settlement that
need to be remedied should it occur

sessment of Concrete Superstructure

ıg concrete superstructure was
ırough a combination of field
on, laboratory testing, and structural
'he concrete superstructure exhibited
ɔn (Figure 3) in varying degrees,
cracks, delaminations and spalling,
ɜed and corroded reinforcing steel.
water leakage, cyclic freezing and
nd corrosion from deicing salts were
ıs the primary causes of deterioration.

Figure 3. Efflorescence, leakage and deterio
concrete along construction joint in track dec

ıensive rehabilitation program that
artial depth and localized full-depth
ɛpairs, galvanic cathodic protection
on mitigation, new deck
fing, and improved deck drainage
ıs developed to restore deteriorated
nd enhance long-term durability to meet the desired 50-year service life extension

ırrent Status

tion of Union Depot is scheduled for completion by December 2012. In the southe
ɛ deck, the majority of the deck and foundations were demolished and reconstruct
ıe original historic appearance; at select locations where deck replacement was di
ɾas retained and the existing piles caps underpinned. In the northern two-thirds of
he existing concrete deck and columns were retained and repaired, and the existin