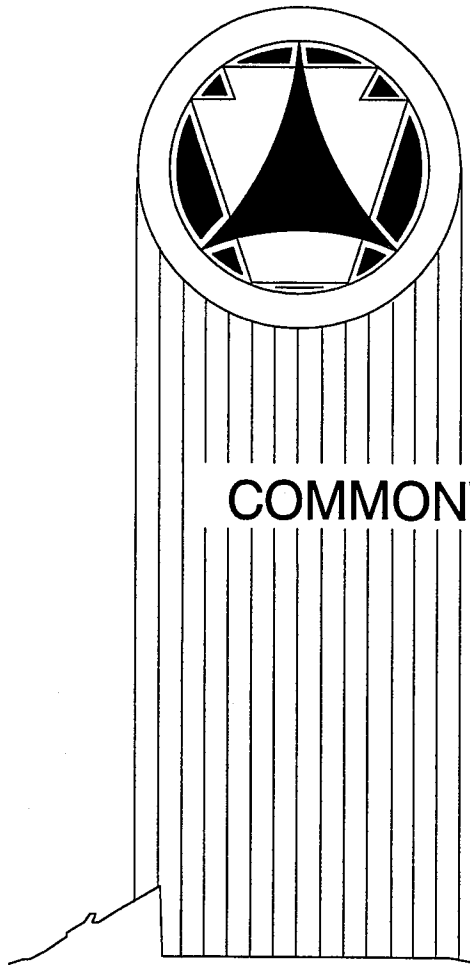

COMMONWEALTH OF PENNSYLVANIA

Department of Transportation

RESEARCH PROJECT NO. 98-051

Evaluation of Timber Blocks for Temporary Inserts in Concrete Patching

FINAL REPORT
JULY 1999

Prepared by:
Marcella Jo Lucas and Carrie H. Howrylak

PENNSYLVANIA DEPARTMENT OF TRANSPORTATION
BUREAU OF CONSTRUCTION AND MATERIALS
ENGINEERING TECHNOLOGY AND INFORMATION DIVISION

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The purpose of this final report is to evaluate the use of timber blocks as temporary inserts for concrete patches. Timber blocks are made of creosoted railroad switch ties with an industrial grade plywood covering. A skid resistance material also is applied to the surface for safety. These platforms primarily are used for patching on heavily traveled highways, when construction takes place overnight and it is necessary to reopen the highway to motorists during the day. Previously in this situation, a very limited number of patches could be completed because the existing concrete had to be saw cut, removed, doweled, and the new concrete had to be poured and cured in one shift, allowing no additional work to be done after pouring. The use of timber blocks allows the Contractor to continue working after the concrete pour. While waiting for the concrete to cure, additional patches can be excavated and filled with the temporary timber block inserts. The timber blocks withstand the heavy traffic while the roadway is open, can be removed quickly at the start of the next construction shift, and can be replaced by the permanent concrete patches. Productivity is increased with the use of timber blocks. The timber block inserts are recommended for further use by the department.

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EVALUATION OF TIMBER BLOCKS AS TEMPORARY INSERTS FOR CONCRETE PATCHES

Final Report
Prepared by
Marcella Jo Lucas and Carrie Howrylak

RESEARCH PROJECT NO. 98-051

CONDUCTED BY

PENNSYLVANIA DEPARTMENT OF TRANSPORTATION

BUREAU OF CONSTRUCTION AND MATERIALS

ENGINEERING TECHNOLOGY AND INFORMATION DIVISION

July 1999

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Metric Conversion Factors*

To Convert From:	To:	Multiply By:
Length		
foot (ft)	meter (m)	0.3048
inch (in)	millimeter (mm)	25.4
yard (yd)	meter (m)	0.9144
mile (statute)	kilometer (km)	1.609
Area		
square foot (ft^2)	square meter (m^2)	0.0929
square inch (in^2)	square centimeter (cm^2)	6.451
square yard (yd^2)	square meter (m^2)	0.8361
Volume		
cubic foot (ft^3)	cubic meter (m^3)	0.02832
cubic yard (yd^3)	cubic meter (m^3)	0.00315
gallon (U.S. liquid)	cubic meter (m^3)	0.004546
ounce (U.S. liquid)	cubic centimeter (cm^3)	29.57
Mass		
ounce-mass (avdp)	gram (g)	28.35
pound-mass (avdp)	kilogram (kg)	0.4536
ton (metric)	kilogram (kg)	1000
ton (short, 2000 lbm)	kilogram (kg)	907.2
Density		
pound-mass/cubic foot	kilogram/cubic meter (kg/m^3)	16.02
mass/cubic yard	kilogram/cubic meter (kg/m^3)	0.5933
pound-mass/gallon(U.S.)**	kilogram/cubic meter (kg/m^3)	119.8
pound-mass/gallon(Can.)*	kilogram/cubic meter (kg/m^3)	99.78
Temperature		
deg Celsius (°C)	kelvin (°K)	$t^{\circ}K = (t^{\circ}C + 273.15)$
deg Fahrenheit (°F)	kelvin (°K)	$t^{\circ}K = (t^{\circ}F + 459.67) / 1.8$
deg Fahrenheit (°F)	deg Celsius (°C)	$t^{\circ}C = (t^{\circ}F - 32) / 1.8$

* The reference source for information on SI units and more exact conversion factors is "Metric Practice Guide" ASTM E380.

** One U.S. gallon equals 0.8327 Canadian gallon.

INTRODUCTION

The purpose of this final report is to evaluate the use of timber blocks as temporary inserts for concrete patches. Timber blocks are made of creosoted railroad switch ties with an industrial grade plywood covering. A skid resistance material also is applied to the surface for safety. These platforms primarily are used for patching on heavily traveled highways, when construction takes place overnight and it is necessary to reopen the highway to motorists during the day. Previously in this situation, a very limited number of patches could be completed because the existing concrete had to be saw cut, removed, doweled, and the new concrete had to be poured and cured in one shift, allowing no additional work to be done after pouring. The use of temporary inserts allows the Contractor to remove the timber blocks and pour concrete soon after beginning the work shift, allowing ample cure time. Removal of concrete and placing the temporary blocks can be done during the later hours of the work shift in preparation for the next night's pour. Productivity is greatly increased with the use of timber block inserts.

CONSTRUCTION SUMMARY

The Cumberland County experimental site was along SR 0081, Section 20, between mile markers 33 and 40. Refer to Figures 1 and 2 for the location.

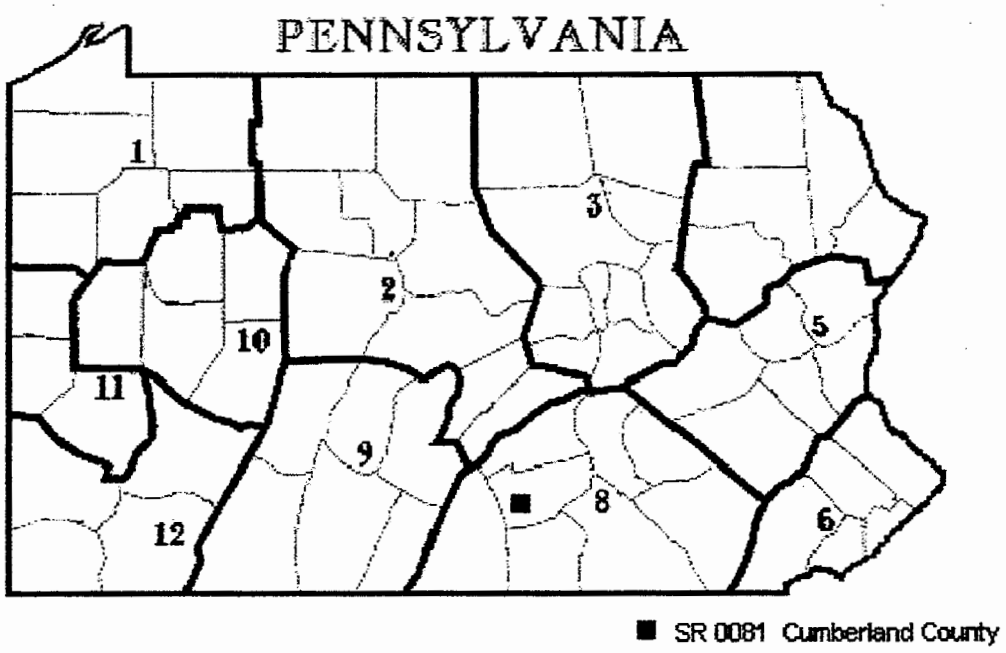


Figure 1 - Site location

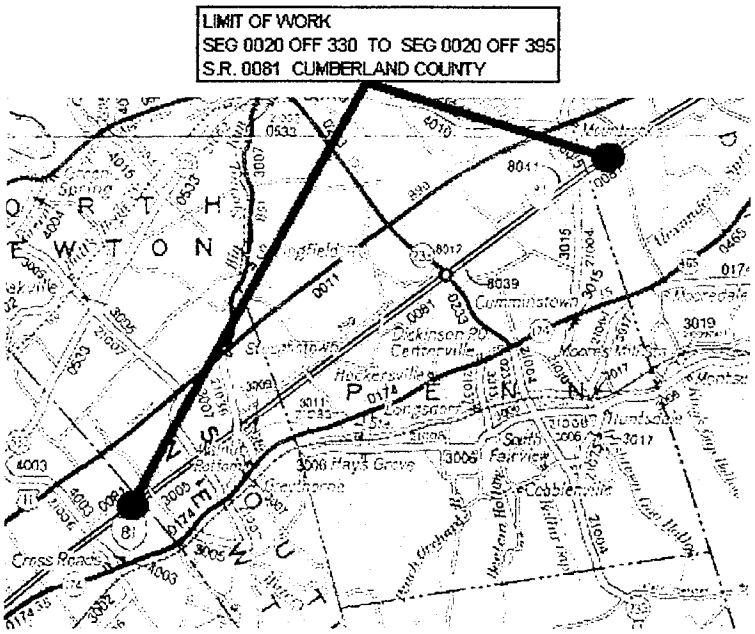


Figure 2—Location map

The timber blocks were prefabricated and delivered to the construction site. The inserts were made up of ten (10) creosoted oak timbers (railroad switch ties), each 7" x 9" x 11'- 9", bolted together with three (3) 1" by 5'-10" long tie bolts. One-inch thick exterior plywood was placed on the top of the timber assembly to provide a uniform surface. The plywood was attached to the timbers with 3" deck screws, spaced approximately one foot apart. Later an epoxy coating was added to the plywood surface. Refer to Figures 3 and 4 for photographs of the completed timber block inserts.

Figure 3—Timber blocks on site

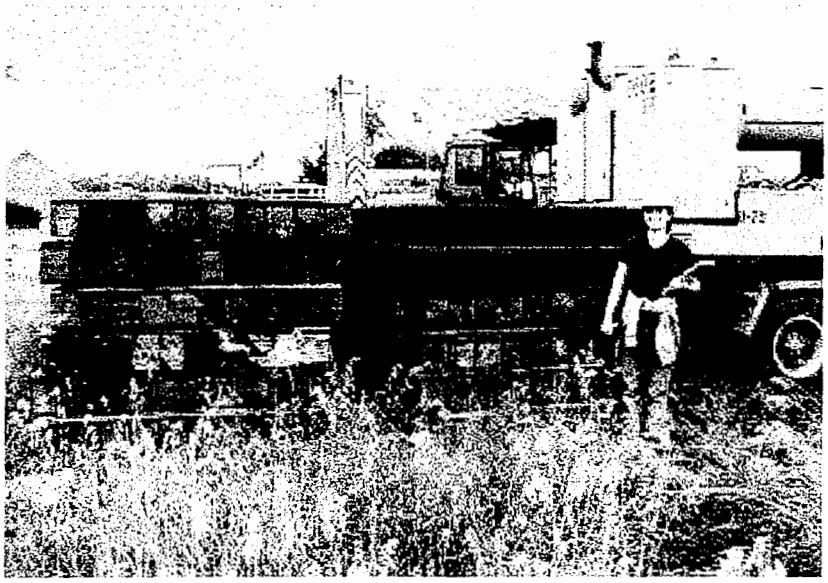


Figure 4—Timber blocks off site

Since each timber block weighs approximately 4,000 pounds, four lifting lugs were installed in the corners for movement of the completed inserts (refer to Figure 5). The lifting lugs were placed in 2" x 5" notches in the timbers and the plywood surface. The all-thread tie bolts were inserted through the lifting lugs.

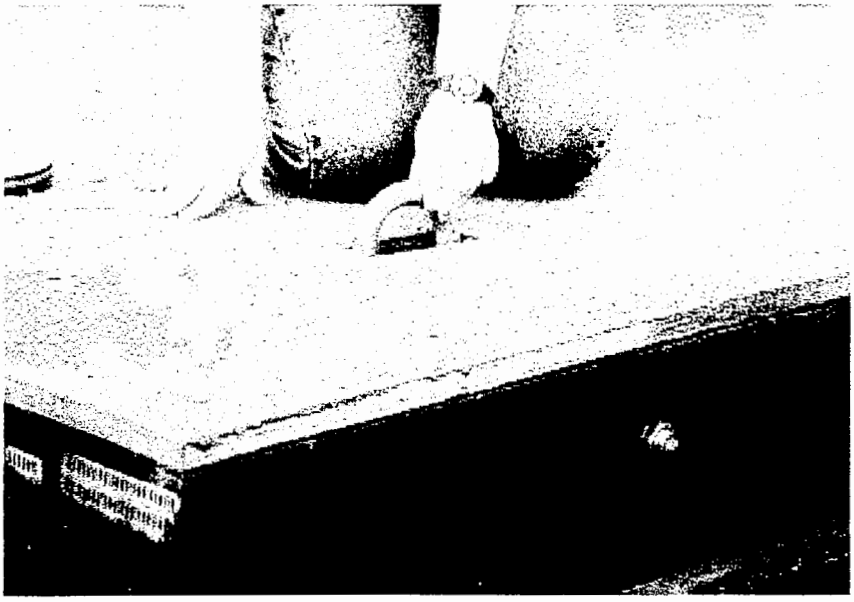


Figure 5—Lifting lug in corner of timber block

Once the block was inserted in a patch, the lifting lugs drop into the notches, out of the way of traffic. The notches can be filled with cold patch material. Figure 6 shows the notch, lifting lug, rod, and epoxy coating.

Figure 6—Top view of lifting lug in the timber block insert

The depth of the existing concrete was 10". The patch holes were cut approximately 6'-3" long by 12'-0" wide. Refer to Figure 7 below.

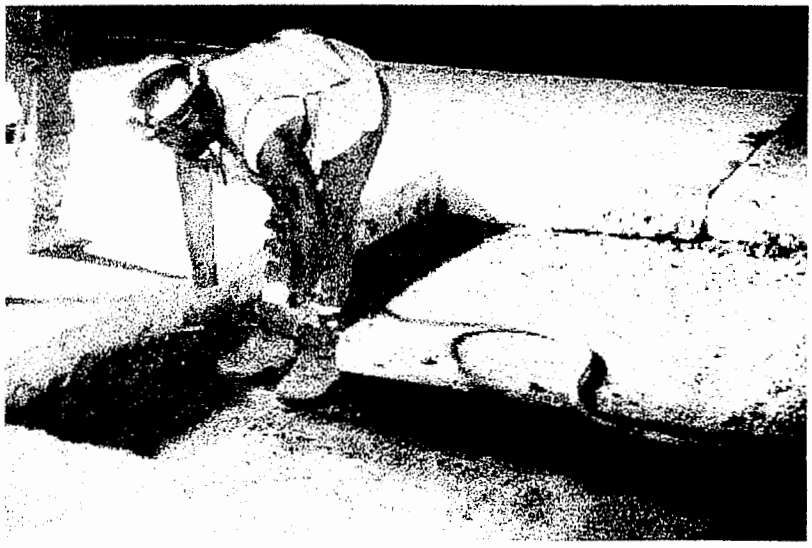


Figure 7—Patch hole

These dimensions allowed approximately 2 ½ inches on either side of the insert, as well as along the longitudinal joint. The inserts were placed flush to ½ inch high to the existing concrete surface. The shoulder adjacent to the patch was excavated for the placement of a steel form for the concrete pour. Sand was placed within the 2 ½ inch gaps between the existing concrete and the timber blocks, to keep the inserts from moving. Cold patch material was placed in the top 2 inches around the inserts. The shoulder also was backfilled with sand and cold patch material. Refer to the following Figures 8 and 9 for placement of the timber blocks.

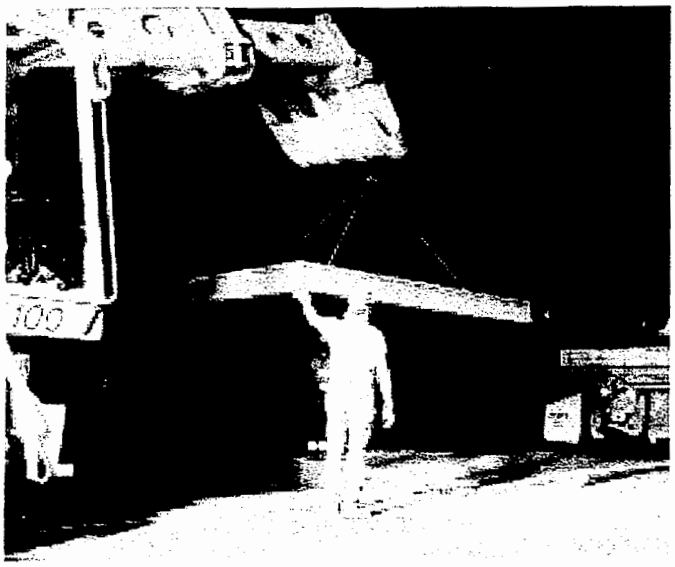


Figure 8—Placement of timber block

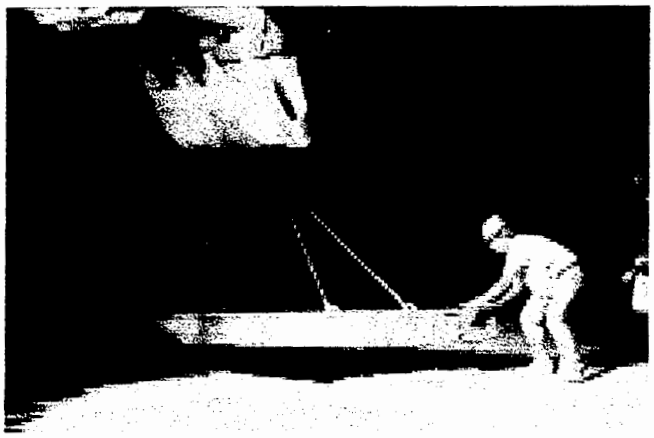


Figure 9—Placement of timber block

Initially the wooden inserts were placed singly, however as the inserts proved to be effective and safe other variations of placement were attempted. One such variation placed two inserts side-by-side for a patch 12' x 12' in size. Another variation placed two or more inserts in a long patch with existing, undisturbed concrete sections between. Another variation placed a 6' x 12' patch into an 8' x 12' patch, with sand and cold patch material filling the gaps.

One of the problems encountered at this test site was that the heads of the 3" deck screws used to secure the plywood to the timbers broke off after repeated use. The deck screws were replaced with hardened 3/8" lag bolts. No problems were observed after this change.

Another concern was the skid resistance of the plywood. After the wooden inserts had been in use, a 2-component epoxy system developed for marine and industrial environments was placed on the plywood surface to ensure durability and to increase skid resistance. Reapplication was needed approximately every 6-8 weeks due to the wear of traffic. Refer to Figure 10 for the conditions of the worn surface. The plywood may require periodic replacement as it is worn (refer to Figure 11).

Figure 10—Worn surface of a timber block insert

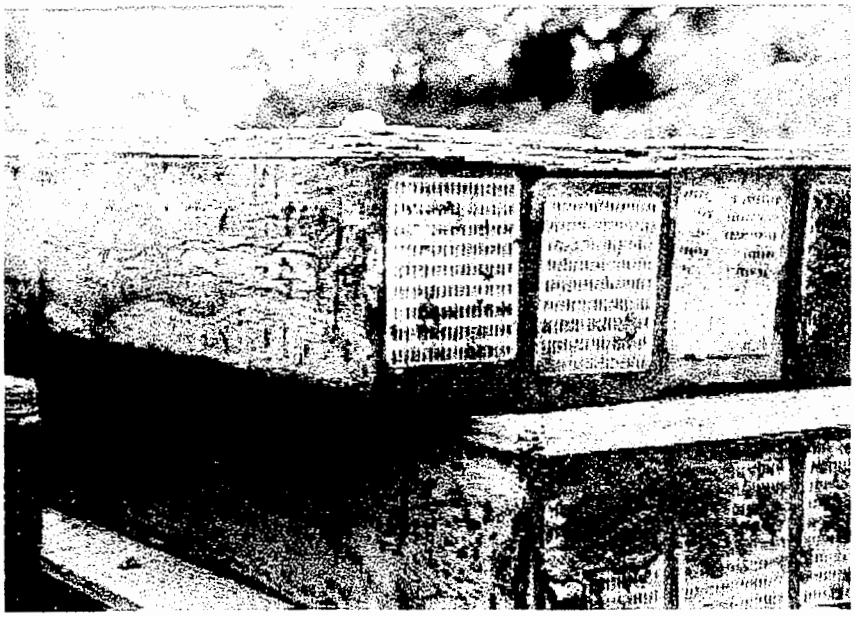


Figure 11—Wear and tear of plywood surface of timber block inserts

COST

The timber block inserts used along SR 0081 were not a pay item in the contract. The timber blocks were considered incidental to the pavement Item Numbers 0590-2234 and 0590-2244, Accelerated Concrete Pavement Patching Type A and Type B, 10" depth. To determine a total cost of one timber block, the following estimates of material and labor were calculated.

Material Estimate:

Quantity	Piece	Price ($)	Total ($)	
10	Wooden 9" x 7" x 11'-9" creosoted timber	50.40	504.00	
3	1" exterior plywood	50.00	150.00	
3	1" all thread tie bolts (inc. washers/ nuts)	32.00	96.00	
72	3/8" lag bolts	0.40	28.80	
4	4.5" x 7" lifting lugs	45.00	180.00	
2	Non-slip deck coating	85.00	170.00	
			1128.80	**Total material cost**

The contractor made six timber blocks in twelve hours. Including the time it took to set up and tear down the equipment, it took approximately three hours to make one timber block. Refer to the following table for an estimate of labor costs.

Labor Estimate:

Hours	Hourly wage ($)	Workers	Total ($)	
3	16.50 (carpenter)	5	247.50	
3	23.50 (operator)	1	70.50	
			318.00	**Total labor cost**

Based on these estimates, the total cost for one timber block is $1446.80. The cost per timber block would decrease as quantity produced increased.

PERFORMANCE AND CONCLUSIONS

The performance of the timber blocks was evaluated during their use. The blocks were barely noticeable when driving over them. With the exception of the gray color of the anti-skid overlay surface, the casual driver would not realize the presence of the blocks in most instances. They performed satisfactorily, increasing the productivity during the nighttime construction shift, while decreasing impact to motorists by allowing all lanes to be opened during the day. The timber blocks maintained stability and endurance during heavy traffic. The timber blocks are recommended for further use by the Department as a means to accomplish concrete pavement repairs with minimal user delays. The timber blocks are incidental to concrete pavement patching item numbers. A copy of the specification and a detailed drawing are in the Appendix. This can be included as a special provision for Department Contracts.

ACKNOWLEDGEMENTS

We would like to extend our thanks to the following for their information and assistance with this project.

- William H. Lindman, Jr., P.E., Project Manager of PAVEX, Inc. for suggesting the use of the timber blocks.
- Brady Smith, Project Superintendent of PAVEX, Inc.
- Valley Quarries, prime contractor of project, for pursuing the option to use the timber blocks.
- Joseph Paladino – PennDOT District 8-0 Construction Project Manager.
- William Brookhart – PennDOT District 8-0 Materials Engineer.

REFERENCES

Klemens, Thomas L., P.E. "When Slab Replacement Resembles A Production Line," Highway and Heavy Construction. October 1990, Pages 28-31.

APPENDIX

SPECIFICATION FOR TIMBER BLOCK INSERTS

DESCRIPTION – Temporary timber inserts to replace removed concrete during patching operations.

MATERIALS –

- Creosoted oak timbers: new railroad switch ties (7" x 9" x 11'-9")* which conform to American Rail Engineering Association specifications.
- Plywood: 1" thick exterior A-C grade.
- Tie bolts: 1" diameter threaded rod, washers, and nuts.
- Lifting lugs (4" x 7 ½" elliptical lifting rings): fabricated steel bar, minimum 1 inch diameter, weight limit 16 tons.
- Lag bolts: 3/8 inch diameter, 2 ½ inches long.
- Epoxy anti-skid surface must conform to High Solids Non-Slip Deck Coating military specification: MIL-PRF-24667A (NAVY) Type I & II, Comp G.

CONSTRUCTION –

1. Arrange 10 creosoted timbers side by side to form a platform of the following dimensions: 5'-10" x 11'-9" x 9" *.

2. Cut notches in the timber block assembly near each corner on the top face of the platform. Set one lifting lug loosely in each notch (four total).

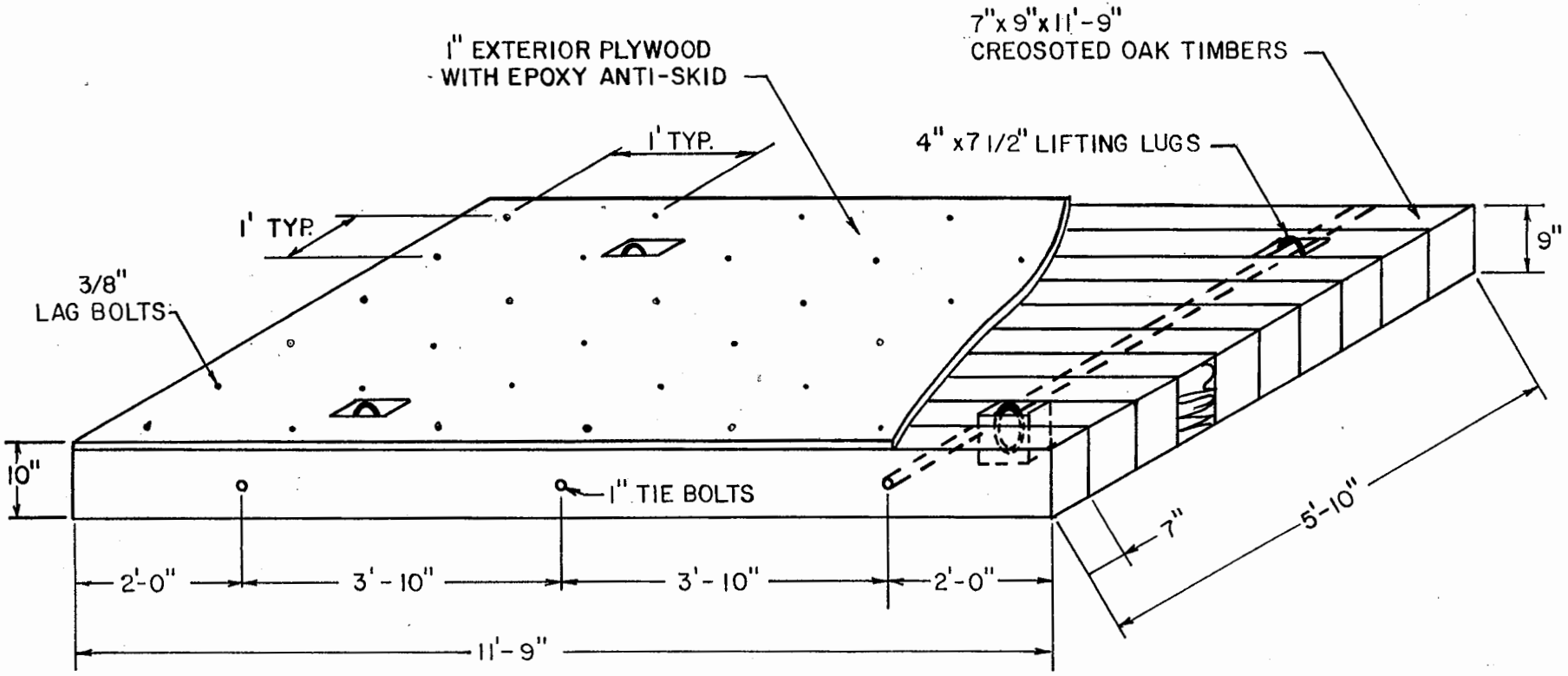
3. Tie the timbers together using three 5'-10" * long tie bolts (with washers and nuts), spaced evenly along the length of the platform. The outer two tie bolts must be threaded through the lifting lugs to complete their attachment.

4. Attach three 1" thick pieces of exterior plywood to the top face of the timber assembly using approximately 72 - ⅜" x 2 ½" lag bolts spaced evenly among the platform. Notches for the lifting lugs must be cut prior to placement of the plywood, large enough to allow free movement of the lifting rings in and out.

5. Coat the top face of the platform (the plywood face) with an epoxy system for skid resistance. Reapply as directed by the engineer.

*These dimensions may vary according to the size of the patch.

TIMBER BLOCK INSERTS



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