

STANDARD  
DETAILS  
OF  
PRE-ENGINEERED  
BRIDGES  
FOR  
MOUNTAIN  
BIKE  
TRAILS

# SCHEDULE OF DRAWINGS

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HOW	HOW TO USE THESE DRAWINGS
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DRAWING  
SCH

## STANDARD DETAILS FOR PRE-ENGINEERED MTB BRIDGES

ENGINEERED BY JON WALDO, P.E., JONESBOROUGH, TENNESSEE

# TIMBER BRIDGE NOTES

## DESIGN CRITERIA –

THESE BRIDGES HAVE BEEN PRE-ENGINEERED SO THAT TRAILWORKERS CAN CHOOSE WHAT TYPE OF BRIDGE WILL WORK BEST BASED ON HOW LONG AND WIDE THE BRIDGE HAS TO BE. THE BRIDGES WERE DESIGNED TO CARRY CYCLISTS AND PEDESTRIANS ACCORDING TO COMMONLY USED BUILDING CODES AND ACCEPTED ENGINEERING PRACTICE. THE WORST CASE SCENARIO FOR THESE BRIDGES IS IF A BUNCH OF PEDESTRIANS CROWD ONTO THE BRIDGE. MAYBE THEY ALL JUMP UP AND DOWN AT THE SAME TIME. THIS IS THE HEAVIEST TYPE OF LOAD THAT IS LIKELY TO EVER OCCUR, AND THAT'S WHAT THESE BRIDGES HAVE BEEN DESIGNED FOR. BY THE WAY, YOU CAN EASILY DRIVE AN ATV OVER THESE BRIDGES – JUST ONE AT A TIME. THE ACTUAL DESIGN LOAD IS 100 POUNDS PER SQUARE FOOT OF DECKING AREA.

## LUMBER –

MOST OUTDOOR TIMBER STRUCTURES, INCLUDING BRIDGES, ARE BUILT OF PRESSURE TREATED LUMBER. THREE TYPES OF LUMBER ARE COMMONLY PRESSURE TREATED. THEY ARE SOUTHERN PINE, DOUGLAS FIR AND HEM-FIR. THESE ARE THE SPECIES OF FINISHED LUMBER THAT ARE USED IN THESE BRIDGES. AS FAR AS LUMBER GRADES ARE CONCERNED, THE BRIDGES EMPLOYING "FINISHED LUMBER" (THE ONES THAT USE 2X STRINGERS) HAVE TO BE BUILT WITH #2 GRADE OR BETTER. THAT MEANS THAT YOU HAVE TO USE #1 OR #2 GRADE LUMBER FOR THE STRINGERS. THE DECKING PIECES CAN BE "CONSTRUCTION" GRADE, "STANDARD" GRADE, OR #2 OR BETTER. THE SPECIES AND GRADE THAT IS USED WILL AFFECT THE STRENGTH OF THE BRIDGE, SO BE SURE THAT YOU KNOW WHAT SPECIES AND GRADE OF LUMBER YOU ARE USING. YOUR LUMBERYARD CAN TELL YOU WHAT SPECIES ARE AVAILABLE AND MAKE SURE THAT YOU ARE USING THE RIGHT GRADE. KEEP IN MIND THAT IT IS SOMETIMES DIFFICULT TO FIND LUMBER LONGER THAN 16 FEET.

## FOOTINGS –

IT IS NECESSARY TO MAKE SURE THAT THE FOOTINGS ARE LOCATED BACK AWAY FROM THE TOP OF THE BANK SO THAT THEY CAN GET GOOD SUPPORT. CLAY SOILS OFFER GOOD SUPPORT AS LONG AS THEY ARE NOT VERY WET. TILL SOILS ARE VERY STRONG, AS ARE ANY SOILS THAT ARE PREDOMINANTLY ROCKY. SANDY AND SILTY SOILS CAN BE A PROBLEM IF THEY ARE WET OR SOFT. YOU CAN PUSH A ROD DOWN THROUGH THE SOIL TO GET AN IDEA OF HOW FIRM IT IS. BE CAREFUL TO MAKE SURE THE BEARING SURFACE FOR THE FOOTING IS SOLID WHEN IT IS EXCAVATED. TAMP IT DOWN IF NECESSARY. IF YOU DIG IT OUT A LITTLE TOO MUCH, FILL IN THE HOLES AND TAMP IT DOWN WELL. BACKFILL AROUND FOOTINGS AFTER CONSTRUCTION IS COMPLETE AND TAMP DOWN.

## HARDWARE –

USE GALVANIZED OR STAINLESS STEEL HARDWARE. GALVANIZED HARDWARE CAN STAIN THE WOOD, BUT THAT IS USUALLY NOT A PROBLEM. REBAR DOES NOT HAVE TO BE GALVANIZED. SIXTEEN PENNY NAILS CAN BE USED FOR MOST NAILING.

DRAWING  
NOTE

## STANDARD DETAILS FOR PRE-ENGINEERED MTB BRIDGES

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# HOW TO USE THESE DRAWINGS

1. DETERMINE HOW WIDE THE BRIDGE DECK HAS TO BE FOR YOUR PARTICULAR APPLICATION.
2. DETERMINE HOW LONG THE SPAN OF THE BRIDGE WILL BE. THE SPAN IS THE OVERALL LENGTH OF THE STRINGERS, NOT JUST THE PART OF THE BRIDGE WITH DECKING ON IT. SEE DRAWING "DECK".
3. DETERMINE WHAT SPECIES OF WOOD YOU ARE GOING TO USE. THESE BRIDGES HAVE BEEN DESIGNED USING THREE COMMON SPECIES OF LUMBER, SOUTHERN PINE, DOUGLAS FIR AND HEM-FIR, USING #2 GRADE OR BETTER LUMBER.
4. BROWSE THROUGH THE DIFFERENT DRAWINGS TO SEE WHAT KIND OF DECK AND STRINGER ARRANGEMENT WILL WORK FOR THE WIDTH AND SPAN THAT YOU REQUIRE. THE TABLE AT THE BOTTOM OF EACH SHEET INDICATES WHAT WIDTHS AND SPANS CAN BE ACCOMODATED BY THE BRIDGES FOR EACH SPECIES OF LUMBER. FOR INSTANCE, IF I AM USING #2 SOUTHERN PINE, AND I KNOW I NEED A FOUR FOOT WIDE BRIDGE AND IT NEEDS TO HAVE A TWELVE FOOT SPAN, I CAN LOOK THROUGH THE DRAWINGS AND SEE FROM THE NOTES THAT (4) 2X6 STRINGERS WILL NOT WORK, BECAUSE THE BRIDGE IS SUITABLE FOR A FOUR FOOT WIDE DECK WITH A MAXIMUM SPAN OF 8 FEET (SEE DRAWING 4-2X6). THEN I CAN LOOK AT DRAWING 4-2X8 AND SEE THAT THIS ARRANGEMENT ALSO WILL NOT WORK, BECAUSE IT IS SUITABLE FOR A FOUR FOOT WIDE DECK WITH A MAXIMUM SPAN OF 10 FEET. THEN I CAN LOOK AT DRAWING 4-2X10 AND SEE THAT THIS ARRANGEMENT, USING (4) 2X10 STRINGERS, WILL WORK, BECAUSE THE NOTES SAY THAT (4) 2X10'S ARE SUITABLE FOR A FOUR FOOT WIDE DECK WITH A MAXIMUM OF A 12 FOOT SPAN (USING #2 SOUTHERN PINE). THIS IS HOW YOU FIGURE OUT WHAT SIZE STRINGERS WILL WORK.
4. NOTE THAT (4) 2X10'S WILL SUPPORT A LONGER SPAN IF THE BRIDGE IS MADE NARROWER, AND WILL SUPPORT A SHORTER SPAN IF THE BRIDGE DECK IS WIDER. THE SAME PRINCIPLE APPLIES TO ALL OF THE DIFFERENT STRINGER ARRANGEMENTS.
5. ONCE THE STRINGER ARRANGEMENT HAS BEEN SELECTED, USE THE APPROPRIATE DECK AND STRINGER DRAWING FOR THE BRIDGE. REFER TO THE TYPICAL DECK DETAIL AND THE APPROPRIATE FOOTING DETAIL FOR THE TYPE OF CONSTRUCTION BEING USED.

DRAWING  
HOW

## STANDARD DETAILS FOR PRE-ENGINEERED MTB BRIDGES

ENGINEERED BY JON WALDO, P.E., JONESBOROUGH, TENNESSEE

# EXAMPLE 1

## PROBLEM:

DESIGN A BRIDGE FOR A SPAN THAT NEEDS TO BE FOUR FEET WIDE BY TEN FEET LONG. YOU PLAN TO USE FINISHED LUMBER AND THE LUMBERYARD HAS #2 DOUGLAS FIR IN STOCK.

## SOLUTION:

1. REFER TO DRAWING "DECK" TO FAMILIARIZE YOURSELF WITH THE GENERAL DECK ARRANGEMENT. YOU WILL BE USING 2X4'S 2X6'S OR SOMETHING SIMILAR FOR THE DECK.
2. NEXT, LOOK AT DRAWING "4-2X6". IT SHOWS A SECTION THRU A BRIDGE MADE WITH 2X DECKING OVER (4) 2X6 STRINGERS. THE TABLE AT THE BOTTOM OF THE SHEET SHOWS THAT THE BRIDGE, USING #2 DOUGLAS FIR FOR THE STRINGERS, WILL SUPPORT A FOUR FOOT WIDE DECK WITH A MAXIMUM SPAN OF SEVEN FEET. YOU NEED A TEN FOOT SPAN, SO THIS BRIDGE WILL NOT WORK.
3. TRY (4) 2X8'S. LOOK AT SHEET "4-2X8" AND NOTICE THAT THE TABLE SAYS THAT THIS BRIDGE WILL SPAN NINE FEET WITH A FOUR FOOT WIDE DECK. THIS IS STILL NOT LONG ENOUGH.
4. TRY (4) 2X10'S. SHEET "4-2X10" SHOWS THAT THIS BRIDGE WILL SPAN ELEVEN FEET WITH A FOUR FOOT WIDE DECK, SO THIS BRIDGE WILL WORK. BUILD THE BRIDGE FOUR FEET WIDE BY TEN FEET LONG USING (4) 2X10'S FOR THE STRINGERS. FOR THE DECKING, USE "CONSTRUCTION" GRADE, "STANDARD" GRADE, OR BETTER.
5. SEE DRAWING "2XFTG" FOR TYPICAL FOOTING DETAILS.

DRAWING  
EX1

## STANDARD DETAILS FOR PRE-ENGINEERED MTB BRIDGES

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## EXAMPLE 2

### PROBLEM:

DESIGN A BRIDGE THAT NEEDS TO BE THREE FEET WIDE BY TWELVE FEET LONG. YOU HAVE TWO SECTIONS OF OLD UTILITY POLES THAT ARE FIFTEEN FEET LONG AND YOU WANT TO TRY TO USE THEM FOR THE BRIDGE. YOU HAVE MEASURED THE DIAMETER OF THE POLES, AND THE SMALLEST ONE HAS A DIAMETER AT ITS SMALLEST END OF A LITTLE MORE THAN EIGHT INCHES. YOU WILL ASSUME THAT THE POLES ARE EIGHT INCHES IN DIAMETER, SINCE THEY ARE AT LEAST THAT BIG ALONG THEIR ENTIRE LENGTH.

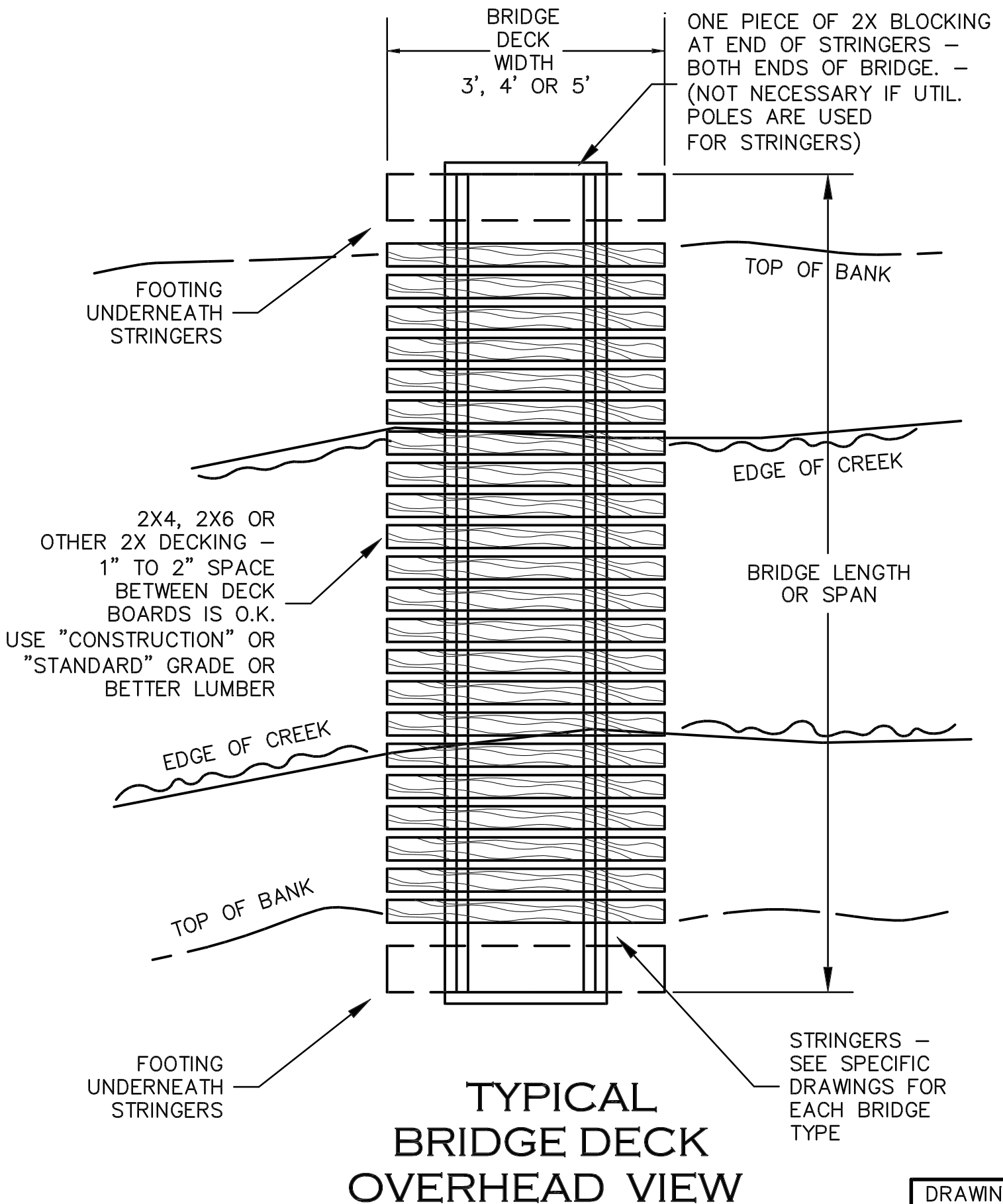
### SOLUTION:

1. REFER TO DRAWING "DECK" TO FAMILIARIZE YOURSELF WITH THE GENERAL DECK ARRANGEMENT. YOU WILL BE USING 2X4'S 2X6'S OR SOMETHING SIMILAR FOR THE DECK.
2. NEXT, LOOK AT DRAWING "2-8UP". IT SHOWS A SECTION THRU A BRIDGE MADE WITH 2X DECKING OVER (2) 8" UTILITY POLE STRINGERS. THE NOTES AT THE BOTTOM OF THE SHEET SHOW THAT THE BRIDGE WILL SUPPORT A THREE FOOT WIDE DECK WITH A MAXIMUM SPAN OF FIFTEEN FEET. SINCE YOU ONLY NEED A TWELVE FOOT SPAN, THIS BRIDGE WILL BE SUFFICIENT. FOR THE DECKING, USE "CONSTRUCTION" GRADE, "STANDARD" GRADE, OR BETTER.
5. SEE DRAWING "UPFTG" FOR TYPICAL FOOTING DETAILS. YOU WILL USE A THREE FOOT SECTION FROM EACH OF THE POLES FOR THE FOOTINGS AS SHOWN ON THE FOOTING DETAIL SHEET.

DRAWING  
EX2

# STANDARD DETAILS FOR PRE-ENGINEERED MTB BRIDGES

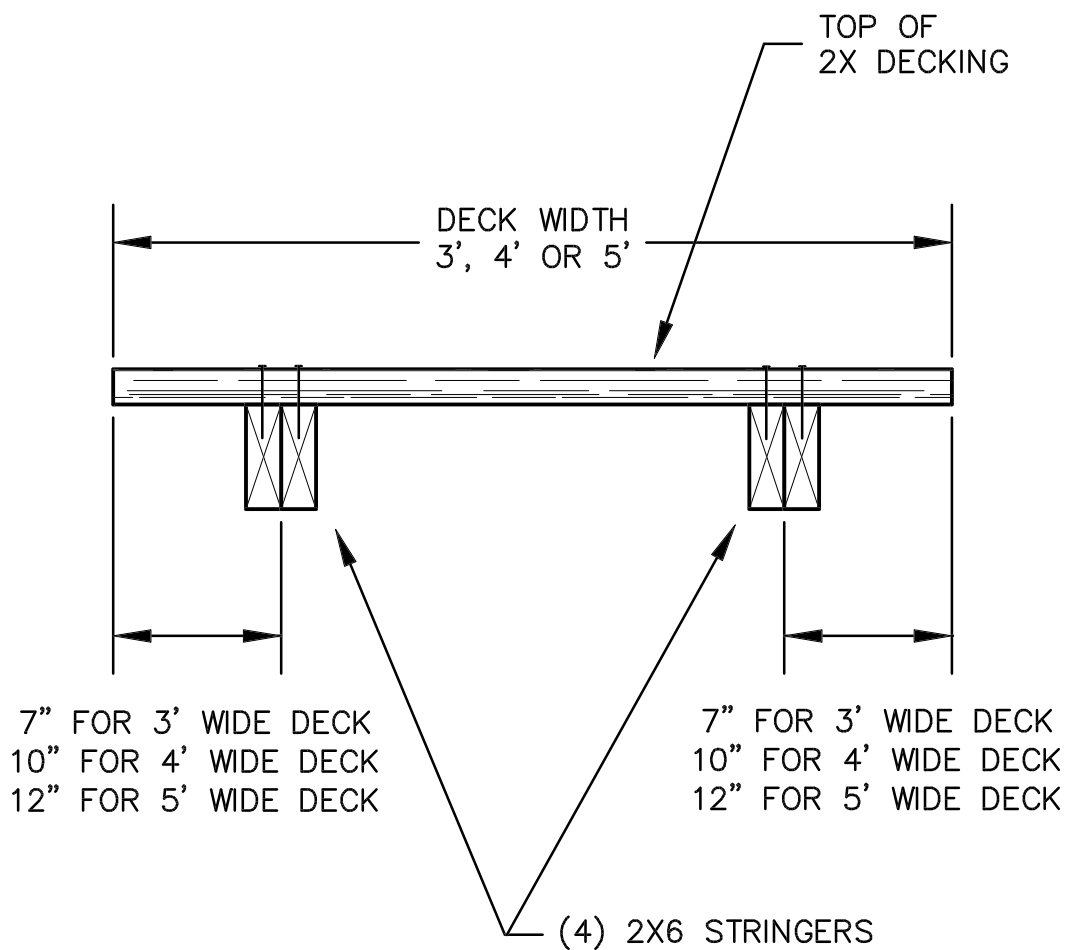
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DRAWING  
DECK

# STANDARD DETAILS FOR PRE-ENGINEERED MTB BRIDGES

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## BRIDGE DECK & STRINGERS USING (4) 2X6 STRINGERS END VIEW

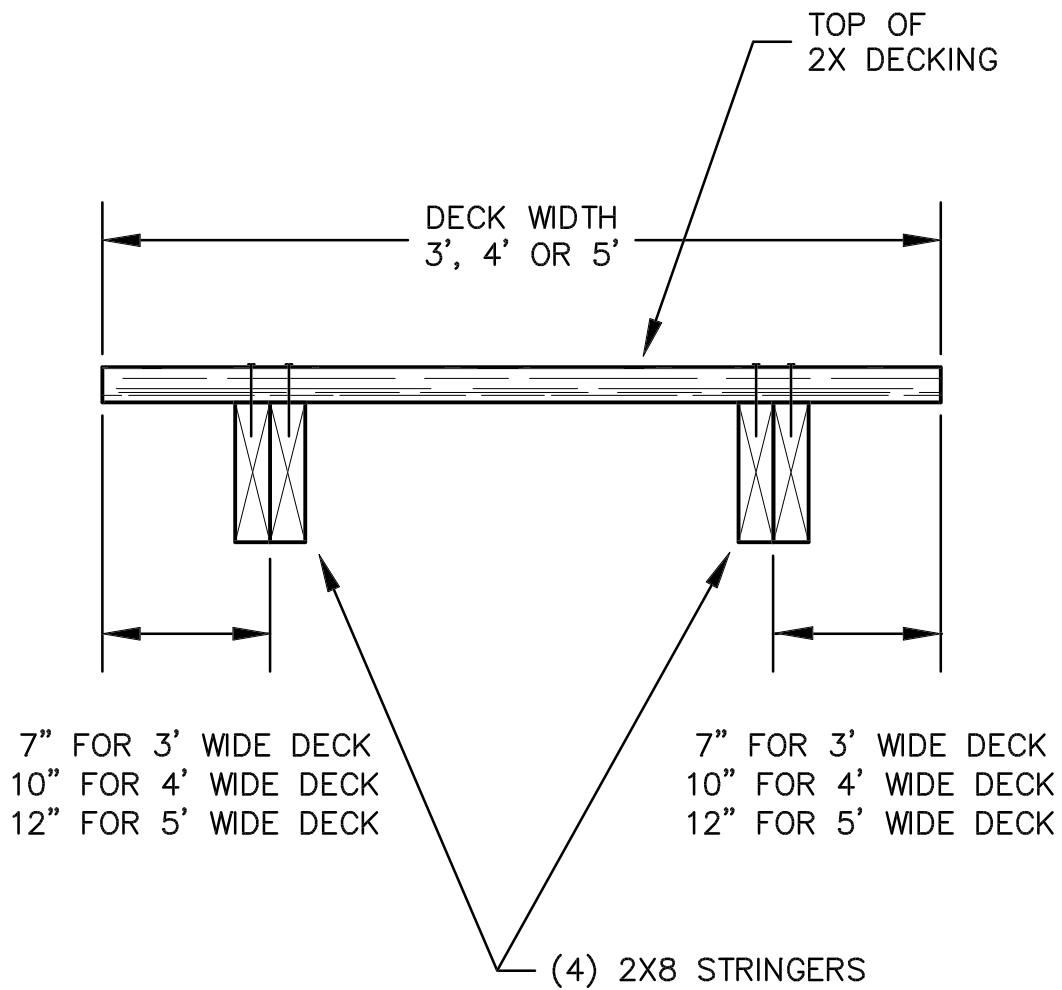
MAXIMUM ALLOWABLE SPANS			
DECK WIDTH \ SPECIES	3' WIDE	4' WIDE	5' WIDE
#2 SO. PINE	9'	8'	7'
#2 DOUG. FIR	8'	7'	6'
#2 HEM-FIR	8'	7'	6'

DRAWING  
4-2X6

# STANDARD DETAILS FOR PRE-ENGINEERED MTB BRIDGES

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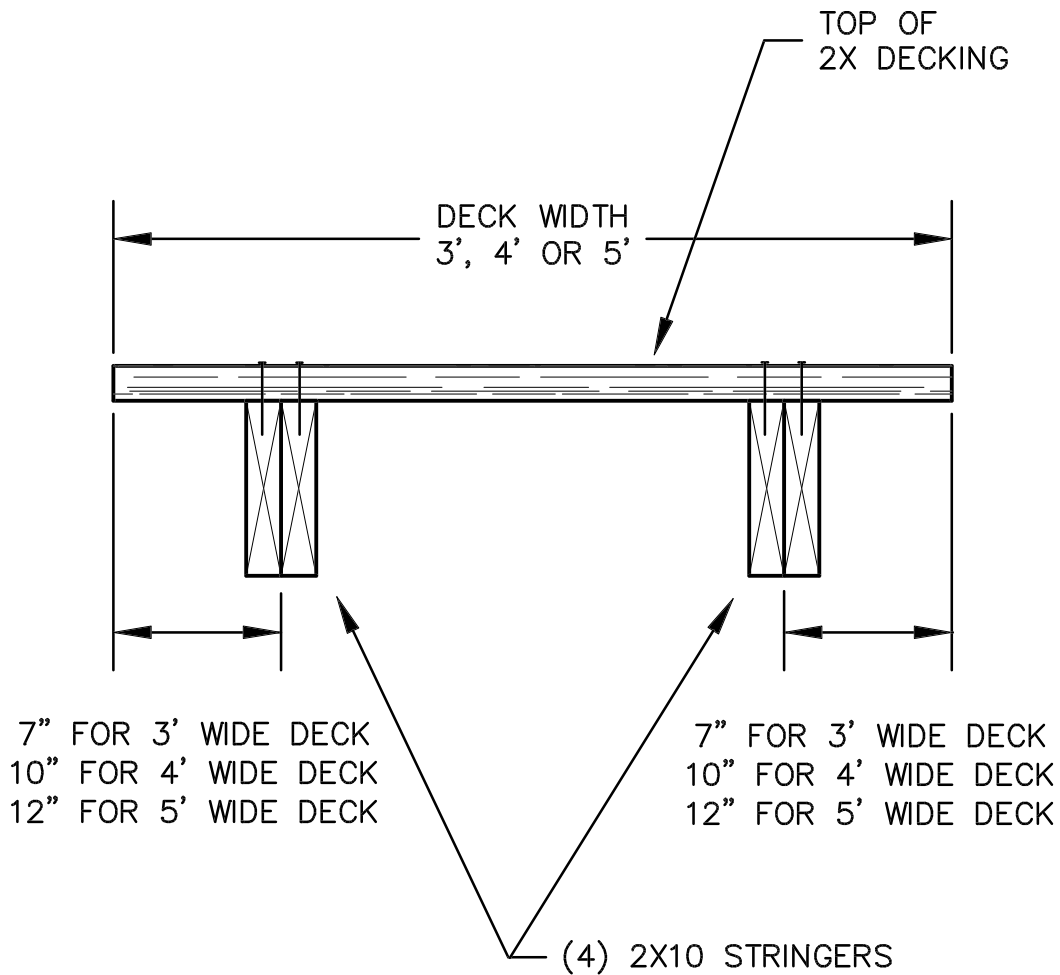
## BRIDGE DECK & STRINGERS USING (4) 2X8 STRINGERS END VIEW

MAXIMUM ALLOWABLE SPANS			
DECK WIDTH \	3' WIDE	4' WIDE	5' WIDE
#2 SO. PINE	12'	10'	9'
#2 DOUG. FIR	10'	9'	8'
#2 HEM-FIR	10'	9'	8'

DRAWING  
4-2X8

# STANDARD DETAILS FOR PRE-ENGINEERED MTB BRIDGES

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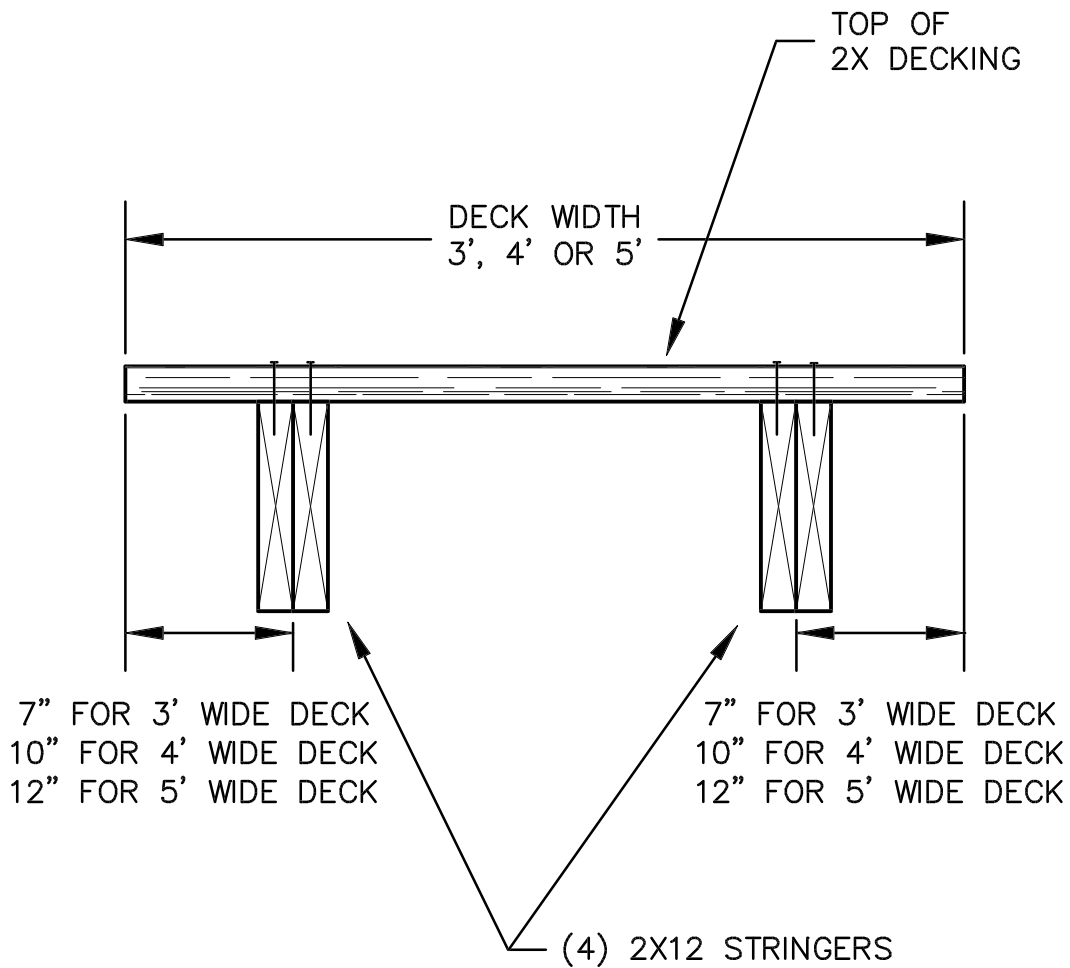
## BRIDGE DECK & STRINGERS USING (4) 2X10 STRINGERS END VIEW

MAXIMUM ALLOWABLE SPANS			
DECK WIDTH	3' WIDE	4' WIDE	5' WIDE
#2 SO. PINE	14'	12'	11'
#2 DOUG. FIR	13'	11'	10'
#2 HEM-FIR	13'	11'	10'

DRAWING  
4-2X10

# STANDARD DETAILS FOR PRE-ENGINEERED MTB BRIDGES

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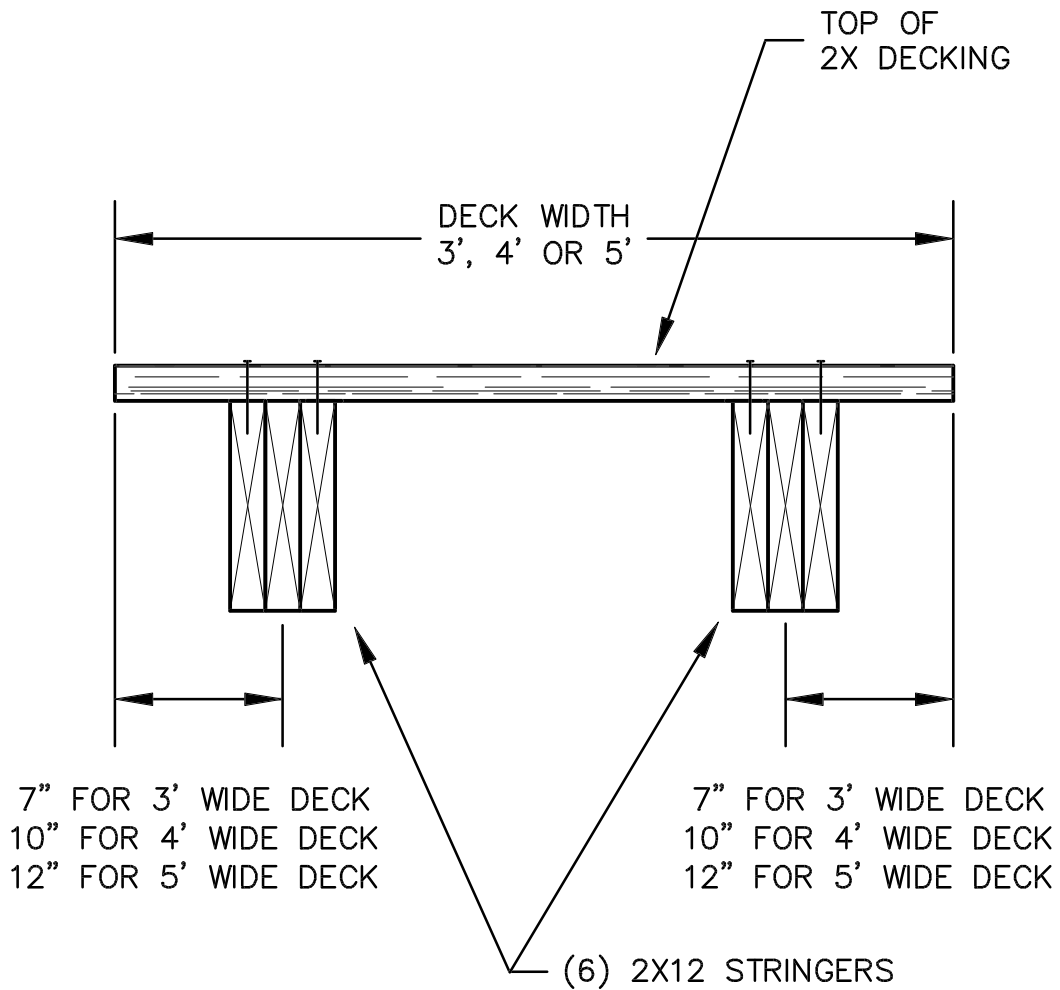
## BRIDGE DECK & STRINGERS USING (4) 2X12 STRINGERS END VIEW

MAXIMUM ALLOWABLE SPANS			
DECK WIDTH SPECIES	3' WIDE	4' WIDE	5' WIDE
#2 SO. PINE	16'	14'	12'
#2 DOUG. FIR	15'	13'	11'
#2 HEM-FIR	15'	13'	11'

DRAWING  
4-2X12

# STANDARD DETAILS FOR PRE-ENGINEERED MTB BRIDGES

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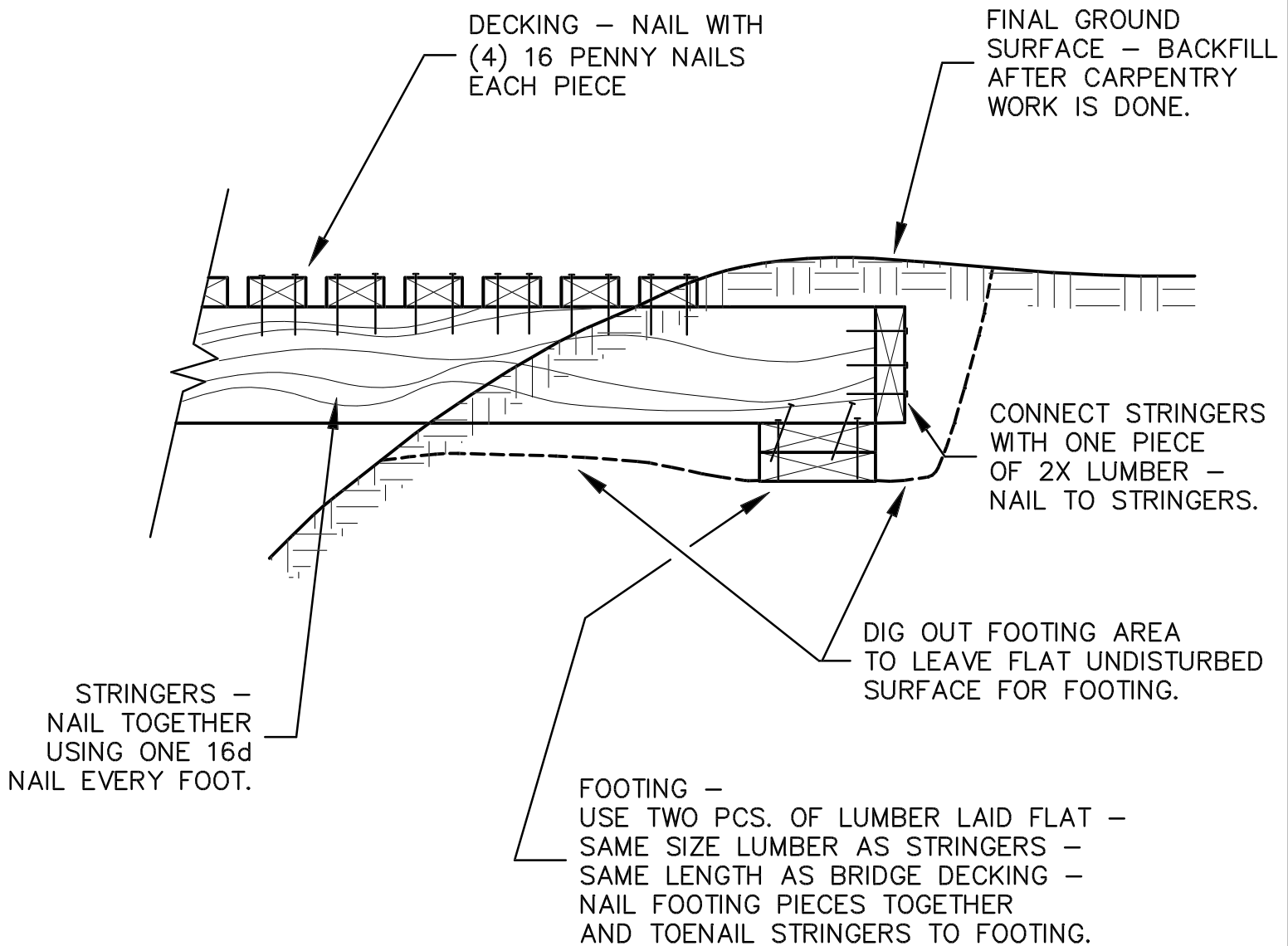
## BRIDGE DECK & STRINGERS USING (6) 2X12 STRINGERS END VIEW

MAXIMUM ALLOWABLE SPANS			
DECK WIDTH \ SPECIES	3' WIDE	4' WIDE	5' WIDE
#2 SO. PINE	20'	17'	15'
#2 DOUG. FIR	18'	15'	14'
#2 HEM-FIR	18'	15'	14'

DRAWING  
6-2X12

# STANDARD DETAILS FOR PRE-ENGINEERED MTB BRIDGES

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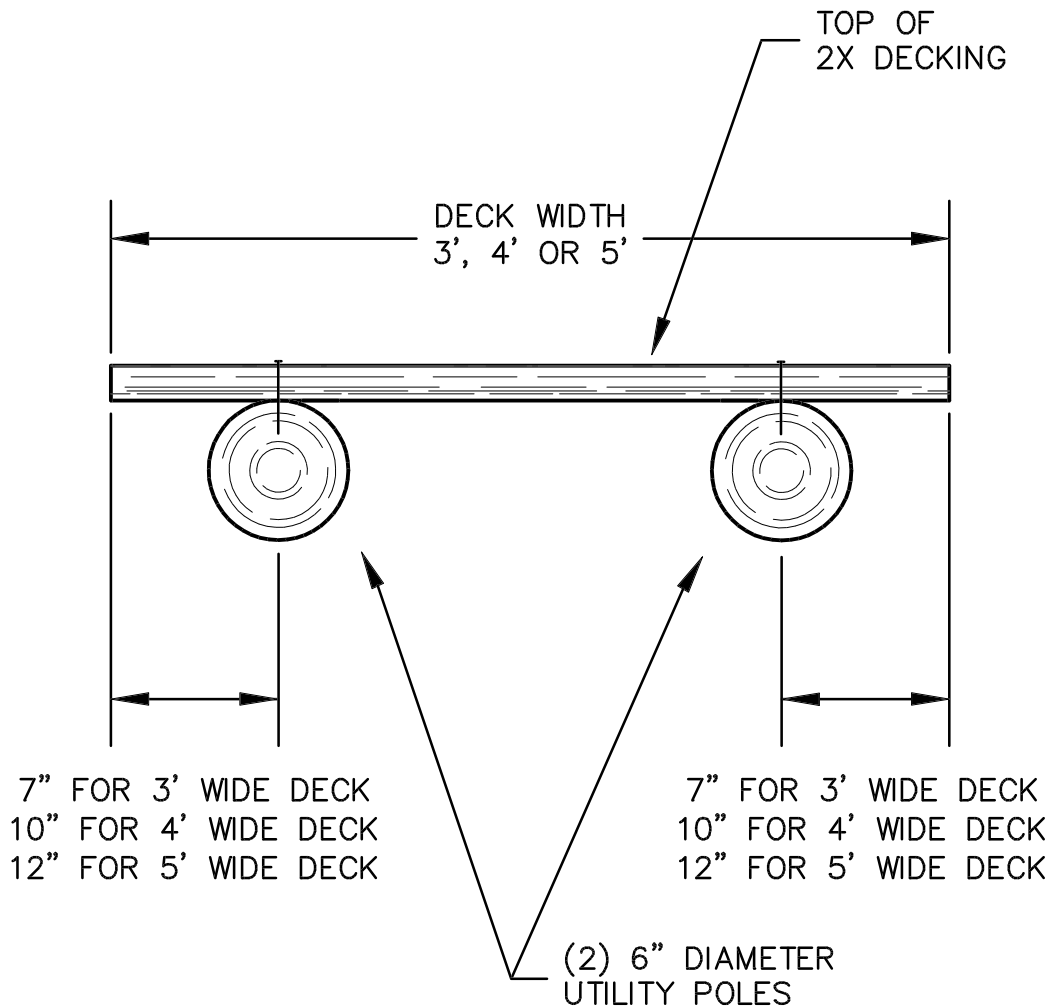


## TYPICAL FOOTING DETAIL FOR USE WITH 2X LUMBER SIDE VIEW

DRAWING  
2XFTG

# STANDARD DETAILS FOR PRE-ENGINEERED MTB BRIDGES

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## BRIDGE DECK & STRINGERS USING (2) 6" DIAMETER UTILITY POLE STRINGERS END VIEW

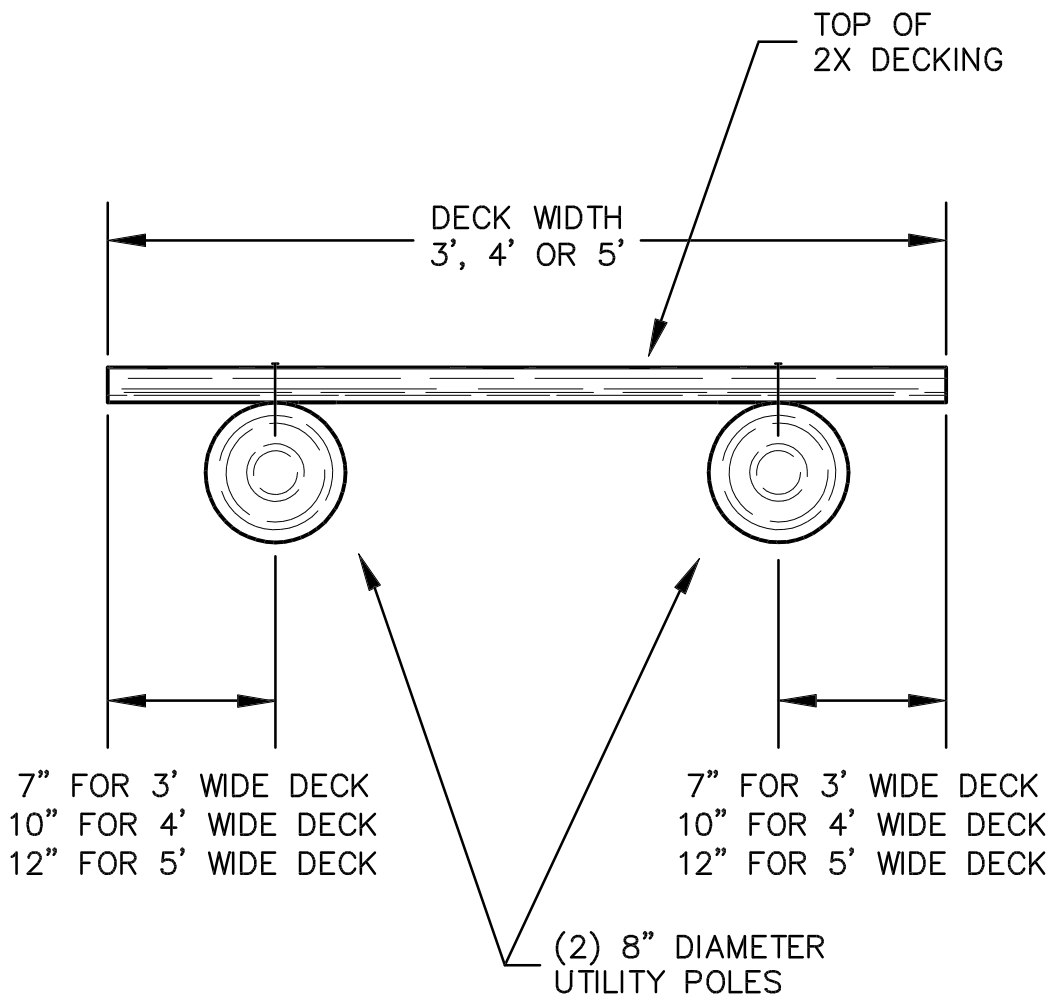
THIS BRIDGE IS SUITABLE FOR:

1. THREE FOOT WIDE DECK X A MAXIMUM OF 10' LONG SPAN,
2. FOUR FOOT WIDE DECK X A MAXIMUM OF 9' LONG SPAN, OR
3. FIVE FOOT WIDE DECK X A MAXIMUM OF 8' LONG SPAN.

DRAWING  
2-6UP

## STANDARD DETAILS FOR PRE-ENGINEERED MTB BRIDGES

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## BRIDGE DECK & STRINGERS USING (2) 8" DIAMETER UTILITY POLE STRINGERS END VIEW

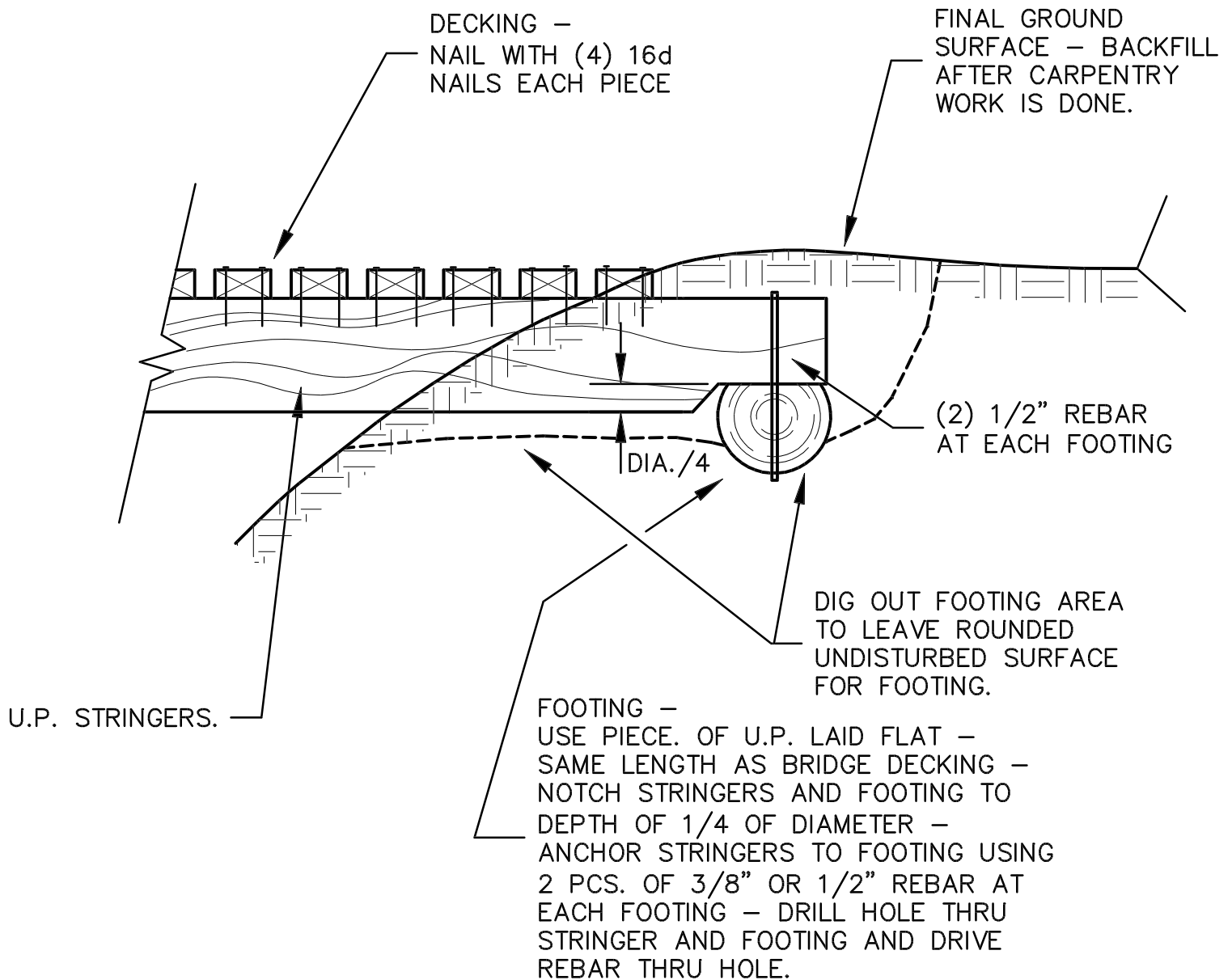
THIS BRIDGE IS SUITABLE FOR:

1. THREE FOOT WIDE DECK X A MAXIMUM OF 15' LONG SPAN,
2. FOUR FOOT WIDE DECK X A MAXIMUM OF 13' LONG SPAN, OR
3. FIVE FOOT WIDE DECK X A MAXIMUM OF 12' LONG SPAN.

DRAWING  
2-8UP

## STANDARD DETAILS FOR PRE-ENGINEERED MTB BRIDGES

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TYPICAL FOOTING DETAIL  
FOR USE WITH UTILITY POLES  
SIDE VIEW

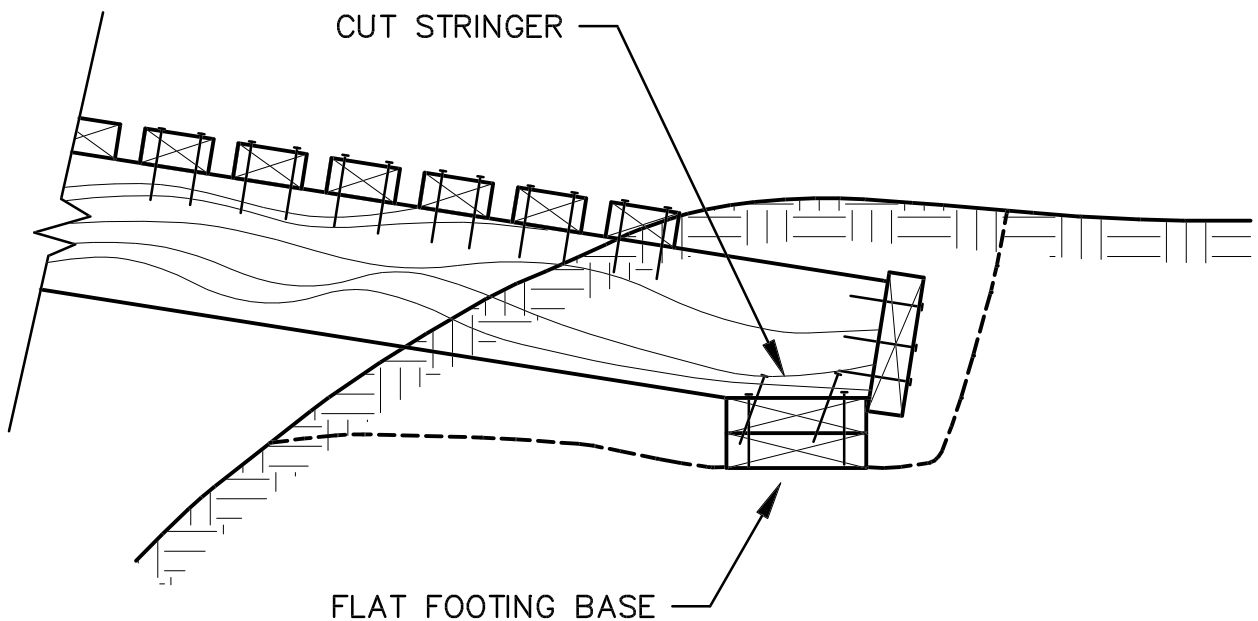
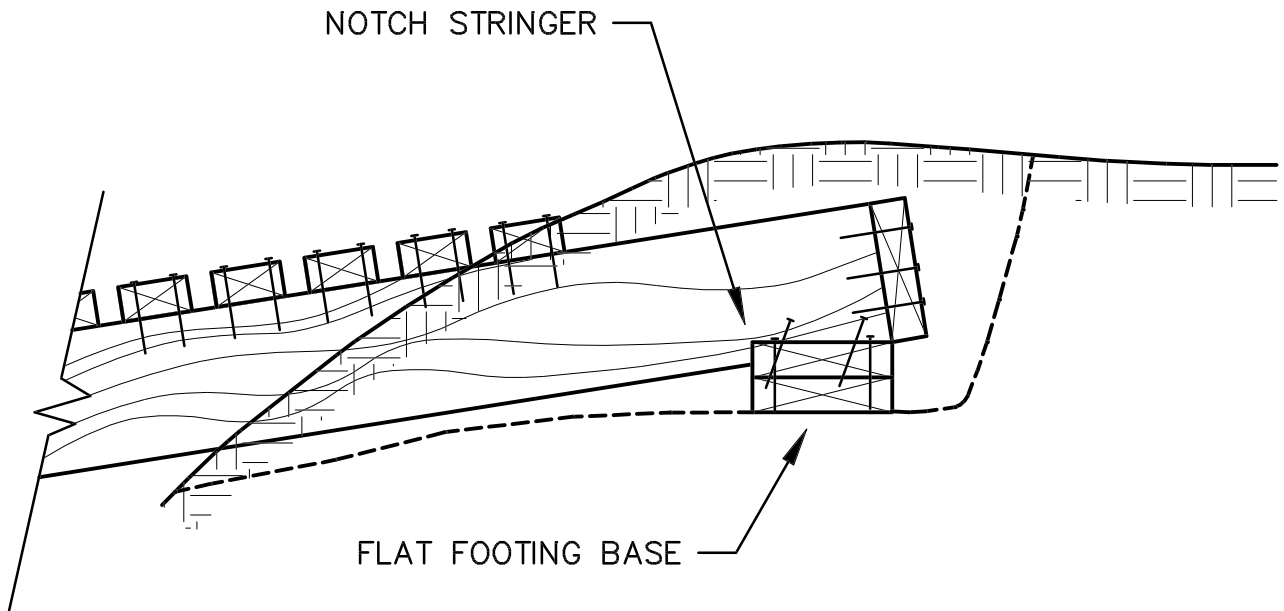
DRAWING  
UPFTG

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- IF STRINGERS ARE SLOPED, MAKE FOOTINGS SO THAT THEY ARE FLAT, AND CUT OR NOTCH STRINGERS.



## FOOTING TIPS FOR SLOPED STRINGERS SIDE VIEW

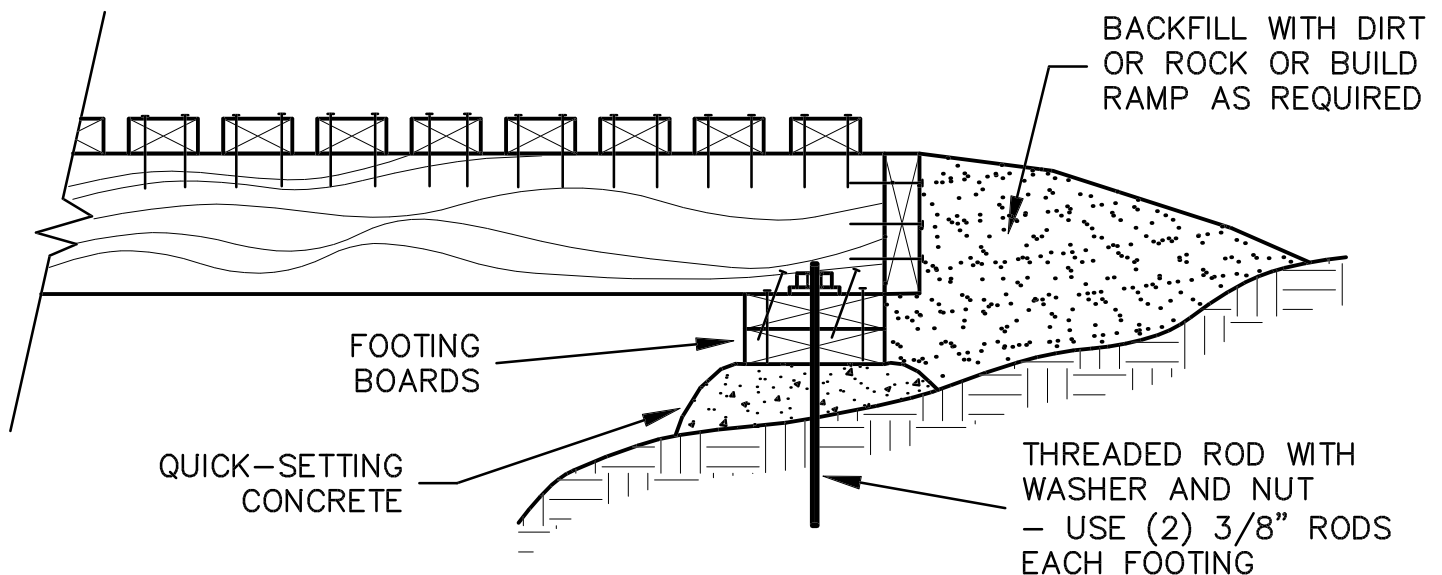
DRAWING  
FTPS 1

# STANDARD DETAILS FOR PRE-ENGINEERED MTB BRIDGES

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# FOOTINGS ON ROCK -

1. DRILL TWO 1/2" X 6" (MINIMUM DEPTH) HOLES IN THE ROCK. LOCATE THEM 3" FROM THE ENDS OF THE FOOTINGS. CLEAN THE HOLES THOROUGHLY. EPOXY THE RODS INTO THE HOLES. LET THE EPOXY SET.
2. MIX UP A BAG OF QUICK-SETTING CONCRETE MIX IN A TUB OR WHEELBARROW. MAKE IT FAIRLY DRY - ENOUGH WATER TO JUST SATURATE THE MIX WITHOUT MAKING IT SLUMP TOO MUCH.
3. DUMP THE CONCRETE ONTO THE CLEANED ROCK SURFACE. HOLD IT IN PLACE AS NECESSARY USING BOARDS, ROCKS, ETC. DRILL OUT THE FOOTING BOARDS AND PLACE THEM ON TOP OF THE CONCRETE. SAVE A LITTLE CONCRETE IN YOUR TUB IN CASE YOU HAVE TO USE IT TO FILL IN ANY VOIDS AFTER YOU GET ALL THE BOARDS IN PLACE.
4. LET THE CONCRETE SET. STRIP AWAY ANY FORM BOARDS, LEAVING THE FOOTING BOARDS INTACT. THEN INSTALL WASHERS AND NUTS ON EACH OF THE ANCHOR RODS, TIGHTEN THEM, AND YOU'RE READY TO BUILD THE REST OF YOUR BRIDGE.
5. DON'T WORRY IF THE RODS END UP BEING OUT OF PLUMB OR IF THE WORK IS MESSY. AS LONG AS THE RODS ARE ANCHORED WELL AND THE CONCRETE IS INTACT, THE FOOTINGS WILL BE FINE.



## FOOTING TIPS FOR FOOTINGS ON ROCK SIDE VIEW

DRAWING  
FTPS2

### STANDARD DETAILS FOR PRE-ENGINEERED MTB BRIDGES

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