

QuadGuard[®] II

Product Description Manual



TRINITY
HIGHWAY

Ahead of the Curve[®]

QuadGuard® II

The QuadGuard® II has been tested pursuant to National Cooperative Highway Research Program (“NCHRP Report 350”) specifications. The QuadGuard® II has been deemed eligible for federal-aid reimbursement on the National Highway System by the Federal Highway Administration (“FHWA”).

Product Description Manual



Warning: The local highway authority, distributors, owners, contractors, lessors, and lessees are responsible for the assembly, maintenance, and repair of the QuadGuard® II. Failure to fulfill these **RESPONSIBILITIES** with respect to the assembly, maintenance, and repair of the QuadGuard® II could result in serious injury or death.

The instructions contained in this manual supersede all previous information and manuals. All information, illustrations, and specifications in this manual are based on the latest QuadGuard® II information available to Trinity Highway at the time of printing. We reserve the right to make changes at any time. Please contact Trinity Highway to confirm that you are referring to the most current instructions.

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Customer Service Contacts

Trinity Highway is committed to the highest level of customer service. Feedback regarding the QuadGuard® II, its assembly procedures, supporting documentation, and performance is always welcome. Additional information can be obtained from the contact information below:

Trinity Highway

Telephone	(888) 323-6374 (USA) +1 312 467 6750 (International)
E-mail	TrinityHighway.com/Contact
Website	TrinityHighway.com

Limitations and Warnings

Trinity Highway contracts with FHWA approved testing facilities to perform crash tests, evaluate test results, and submit results to the FHWA for review.

The QuadGuard® II has been deemed eligible for reimbursement by FHWA as meeting the requirements and guidelines of NCHRP Report 350. NCHRP Report 350 tests are designed to evaluate product performance involving a range of vehicles on roadways, from lightweight cars (approx. 1800 lb. [820 kg]) to full size pickup trucks (approx. 4400 lb. [2000 kg]). A product can be certified for multiple Test Levels. The QuadGuard® II is certified to the Test Level(s) as shown below:

Test Level 2: 43 mph [70 km/h]]

Test Level 3: 62 mph [100 km/h]

These FHWA directed tests are not intended to represent the performance of systems when impacted by every vehicle type or every impact condition existing on the roadway. This system is tested only to the test matrix criteria of NCHRP Report 350 as approved by FHWA.

Trinity Highway expressly disclaims any warranty or liability for injury or damage to persons or property resulting from any impact, collision or harmful contact with products, other vehicles, or nearby hazards or objects by any vehicle, object or person, whether or not the products were assembled in consultation with Trinity Highway or by third parties.

The QuadGuard® II is intended to be assembled, delineated, and maintained within specific state and federal guidelines. It is important for the highway authority specifying the use of a highway product to select the most appropriate product configuration for its site specifications. The customer should be careful to properly select, assemble, and maintain the product. Site lay out, vehicle population type; speed, traffic direction, and visibility are important elements that require evaluation in the selection of a highway product. For example, curbs could cause an untested effect on an impacting vehicle.

After an impact occurs, the debris from the impact should be removed from the area immediately and the specified highway product should be evaluated and restored to its original specified condition or replaced as the highway authority determines as soon as possible.

System Overview

The QuadGuard® II is a potentially reusable, re-directive, non-gating crash cushion for roadside obstacles ranging in width from 24" to 126" [610 mm to 3200 mm]. It consists of energy-absorbing cartridges surrounded by a framework of Quad-Beam™ Panels. The decision as to whether this product is reusable after impact rests solely within the sound discretion of the trained engineer, experienced in highway products, who is working at the direction of the local DOT, or appropriate highway authority, which specified and now owns the product.

The QuadGuard® II utilizes two types of cartridges in a staged configuration designed to address both lighter cars and heavier, high center-of-gravity vehicles. Its modular design allows the system length to be tailored to the design speed and appropriate number of Bays for a site (p. 10).

Impact Performance

The 5 Bay QuadGuard® II has successfully passed the requirements outlined in NCHRP Report 350, Test Level 3 tests with both the light car and pickup at speeds of up to 62 mph [100 km/h] at angles up to 20 degrees.

During head-on impact testing, within NCHRP Report 350 criteria, the QuadGuard® II is designed to telescope rearward to absorb the energy of impact. When impacted from the side, within the applicable NCHRP Report 350 criteria, it is designed to redirect the vehicle back toward its original travel path and away from the roadside obstacle.

How to Determine Left/Right

To determine left from right when ordering parts, stand in front of the system facing the roadside feature. Your left is the system's left and your right is the system's right.

Counting the Number of Bays

One Bay consists of one Cartridge, one Diaphragm, two Fender Panels, etc. The Nose section is not considered a Bay, though there is a Cartridge in the Nose of each system. Note that this means there will always be one more Cartridge in the system than the number of Bays in the system. To determine number of Bays, count Fender Panels on one side (Figure 1).

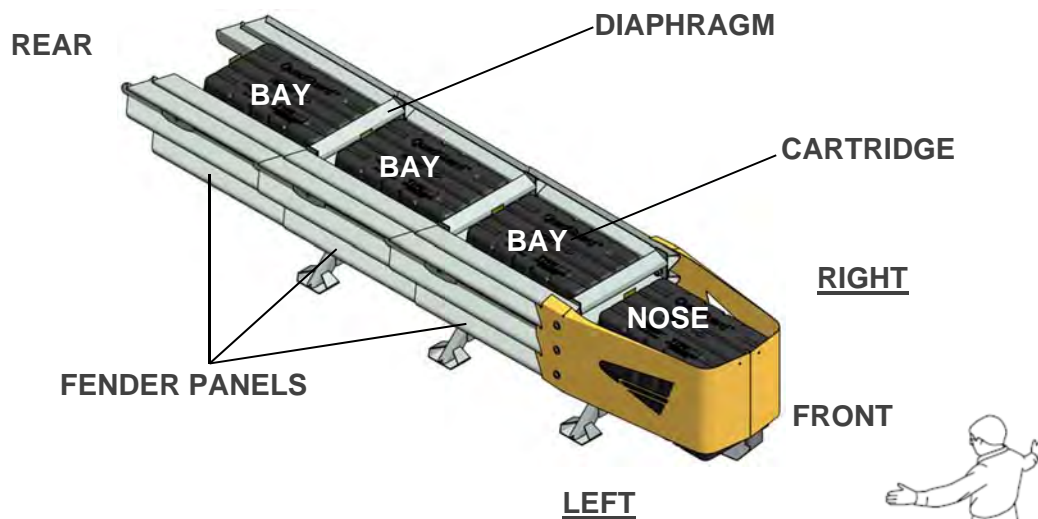


Figure 1
System Orientation
3 - Bay System

Measuring the Width

The QuadGuard® II is available in seven (7) nominal widths:

- 24" [610 mm]
- 30" [760 mm]
- 36" [915 mm]
- 48" [1219 mm]
- 69" [1755 mm] - (Minimum 3 Bays Required)
- 90" [2285 mm] - (Minimum 3 Bays Required)
- 126" [3200 mm] - (Minimum 6 Bays Required)

The nominal width of a parallel system is the width of the diaphragm (Figure 2).

The nominal width of a wide system is the width at the location shown in Figure 3.

The outside width of the system is approximately 6" [150 mm] to 9" [230 mm] wider than the nominal width. The width of the system is not the same as the width of the Backup.

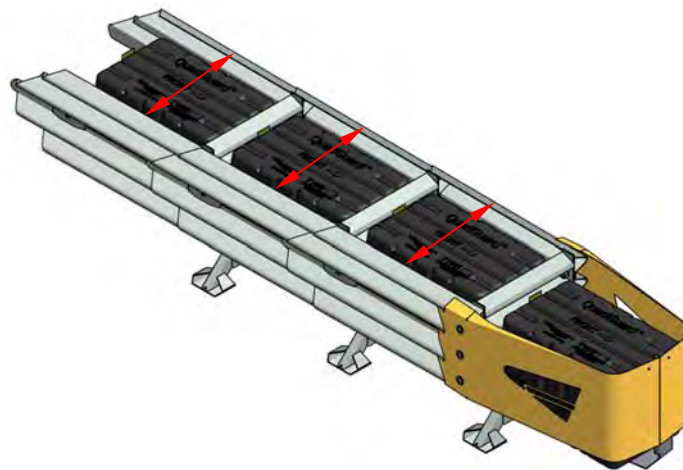


Figure 2
Width of Narrow system

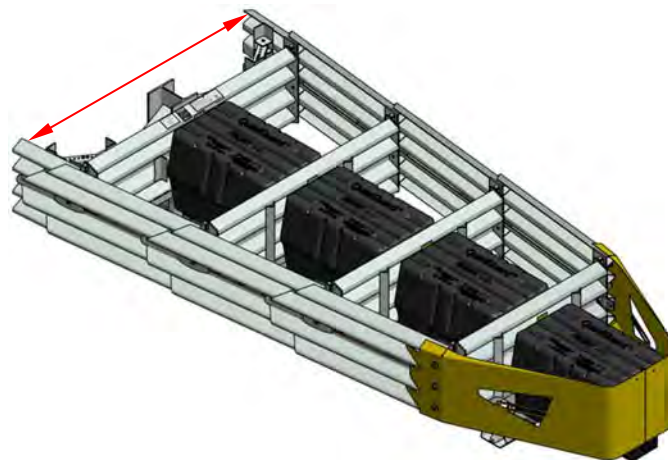


Figure 3
Width of Wide system

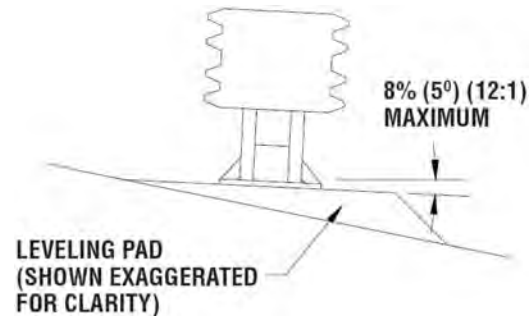
Trinity Highway Approved Adhesive Anchoring System

A Trinity Highway approved adhesive anchoring system is required to securely anchor crash cushions. Each approved adhesive kit contains adhesive, studs, nuts, washers and instructions. Both vertical and horizontal assemblies are possible using an approved adhesive anchoring system.

Site Conditions

Cross-slope exists – If there is a cross-slope of more than 8% (5 degrees), or if the cross-slope varies (twists) more than 2% (1 degree) over the length of the system, a concrete leveling pad may be required (Figure 4).

No cross-slope – No additional action is required.



**Figure 4
Cross-Slope**

1) Specify Backup Structure

The two Backup designs available are the Tension Strut Backup and the Concrete Backup. Both types are appropriate for use on grade or deck.

2) Special Conditions

Contact Trinity Highway Customer Service Department if you would like input with your application. You will need to answer the following questions:

- 1. Are curbs, islands or elevated objects (delineators or signs) present at the site? What height and width are they?** All curbs and elevated objects over 4" [100 mm] high should be removed. If possible, curbs taller than 4" [100 mm] high should be removed approximately 50' [15 m] in front of the QuadGuard® II and as far back as the system's Backup. Any curbs that must remain should be 4" [100 mm] maximum and be mountable.
- 2. What is the angle of divergence** if the construction site is a gore area?

What is the general geometry of the site, including the roadway for at least 500' [150 m] in front, so traffic patterns can be visualized?

- 3. Is there an existing barrier?** Where there is an existing guardrail or median barrier at the site, the Backup of the QuadGuard® II should tie into it when possible.
- 4. Will there be traffic approaching from the rear of the system?** Is the system in a two-way traffic situation, with traffic going in opposite directions on either side of the system? Or, is the system on the side of the road in a location where crossover traffic is a concern? If so, a Transition from the back of the system to the hazard is necessary to prevent vehicle interaction (pp. 12 & 13).
- 5. Are there any other unique features at the site that may affect positioning or performance of the QuadGuard® II?**

3) Other Factors that May Affect Your Deployment:

1. The existence of drain inlets.
2. Junction boxes or other appurtenances located near the hazard.
3. Insufficient space for the length preferred.
4. The location and movement of expansion joints.

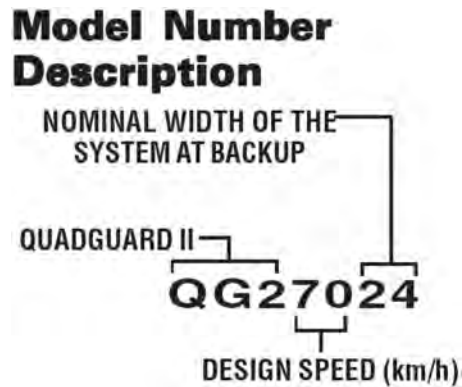
If these or any other special site conditions exist, please contact Trinity Highway Customer Service Department before proceeding with your design (p. 3).



Important: It is the responsibility of the appropriate highway authority to select the location for the QuadGuard II in accordance with the Roadside Design Guide. Trinity Highway is not responsible for choosing the location where a system will be placed.

Impact conditions which differ from those described in the NCHRP Report 350 test matrix for non-gating, redirecting crash cushions may result in different crash results than those encountered in testing.

Furthermore, impacts in excess of TL-3 impact severity, or the existence (at the site of assembly) of curbs or cross-slopes in excess of 8%, may yield performance which does not meet NCHRP Report 350 evaluation criteria relative to structural adequacy, occupant risk and vehicle trajectory factors.



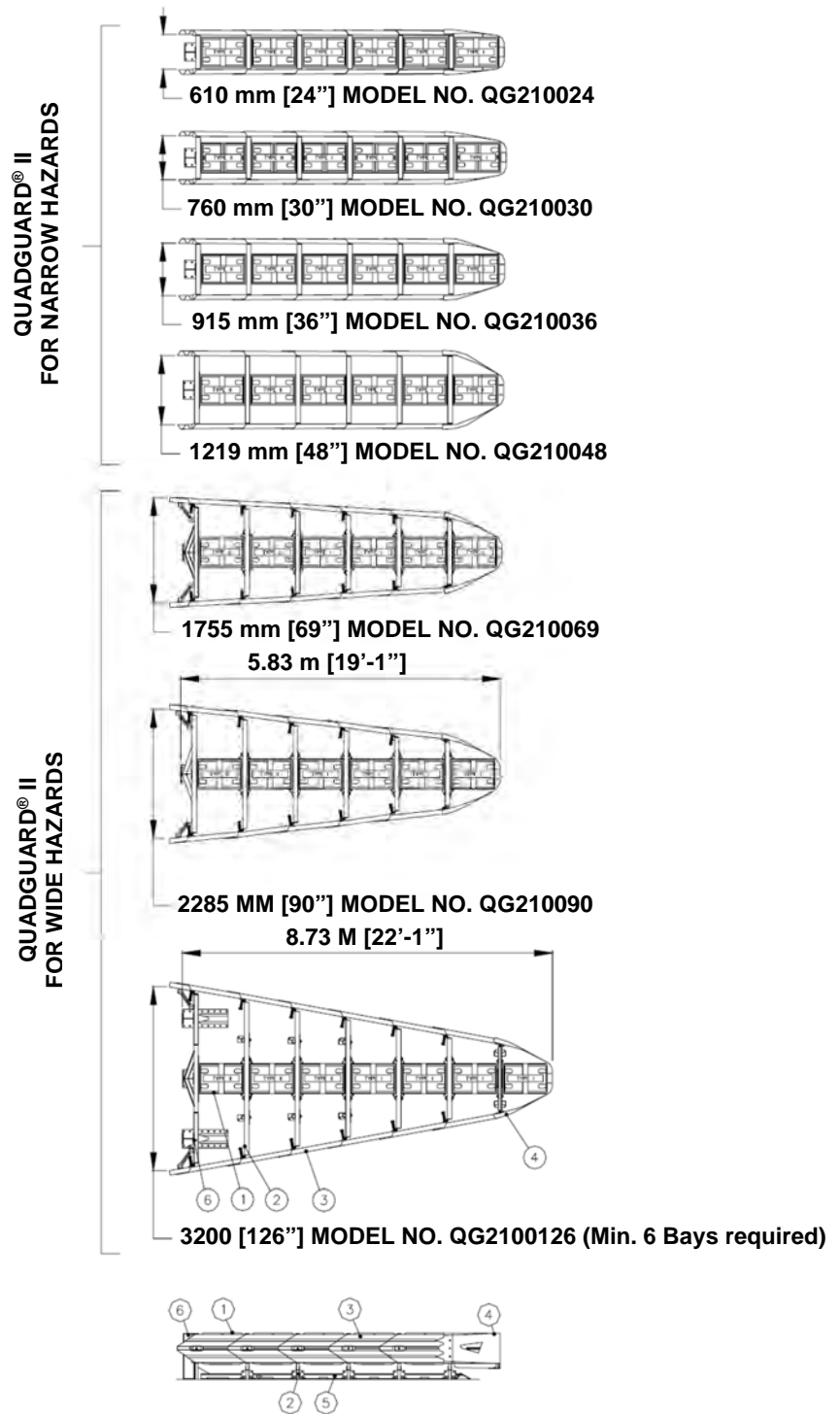
**Figure 5
Model Number Key**

These following charts represent the modified versions of the QG II length relative to impact speed, which is based on the capacity of the system using a 2000 kg [4400 lb.] pickup truck.

Speed & Cartridge Placement Chart For Narrow Systems				
# of Bays	Model #	kph [mph]	Type I	Type II
1*	QG 240__	40 [25]	2	0
2	QG 270__	70 [44]	2	1
3*	QG 280__	80 [50]	2	2
4*	QG 290__	90 [56]	3	2
5	QG 2100__	100 [62]	3	3
6*	QG 2105__	105 [65]	4	3
7*	QG 2110__	110 [68]	4	4
8*	QG 2115__	115 [71]	4	5
9*	QG 2120__	120 [75]	4	6

Speed & Cartridge Placement Chart For Wide Systems				
# of Bays	Model #	kph [mph]	Type I	Type II
3*	QG 270__	70 [44]	2	2
4*	QG 280__	80 [50]	3	2
5*	QG 2100__	100 [62]	3	3
6*	QG 2105__	105 [65]	4	3
7*	QG 2110__	110 [68]	4	4
8*	QG 2115__	115 [71]	4	5
9*	QG 2120__	120 [75]	4	6

*System capacity estimated through calculation.



**Figure 6
Plan & Elevation
5 - Bay system with Tension Strut Backup**

Transitioning

Quad-Beam™ End Shoe Transition Panel

The Quad-Beam™ End Shoe Panel transitions the QuadGuard® II system to vertical faced concrete structures whether it is a concrete Backup or concrete barrier wall (p. 13). An Extended End Shoe is also available. In cases where the corners of the hazard are not chamfered, it may be necessary to add wheel deflectors to the structure in order to prevent wheel interaction.

Quad-Beam™ to Guardrail Transition Panel (W-Beam and Thrie-Beam)

The Quad-Beam™ to W-Beam and Quad-Beam™ to Thrie-Beam Transition Panels transition the QuadGuard® II system to new and existing runs of standard guardrail (p. 13).

Quad-Beam™ to Safety Barrier Transition Panel

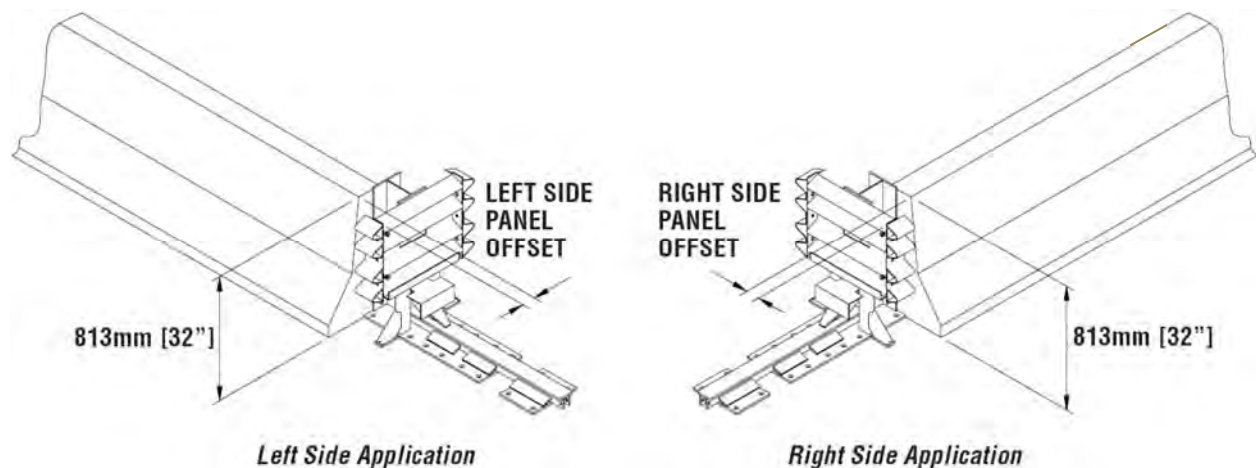
There are several options available when transitioning the QuadGuard® II system to safety shape barrier depending on the shape and position of the barrier.

When transitioning to barriers with a “New Jersey” style profile, the 4” offset Transition Panel is most commonly used (p. 13). For transitioning to barriers that are in line with the side of the system, use transition assembly 616041B or 616044B. For transitioning a wide system to barrier that runs parallel to the centerline of the system, transition assembly 616048B or 616049B is used. A 9” offset Transition Panel is also available for transitioning to barriers that are in line with the side of the system.

When transitioning the Single Slope style barriers and parapets, 6” and 8” offset Transition Panels are available. For transitioning a wide system to barrier that runs parallel to the centerline of the system, a 6” offset panel is available.

How do you determine the Transition Panel offset?

Transition Panel offset is determined by measuring the distance between the face of the barrier and the top edge of the Backup Diaphragm at 32” above ground level (Figure 7). Remember, when assembling the QuadGuard® II that the correct Transition Panel offset must be achieved in order for the offset bracket to nest between the barrier and Transition Panel ensuring proper performance of the transition.



**Figure 7
Transition Panel Offset**

Transition Panel Types

If a system is placed in a location where traffic will be approaching from the rear, a Transition Panel is necessary. Standard panel types are illustrated below and there are variations for each panel type. The specific panel applied will depend on system and site conditions. Therefore, it is important to send site specific data to the Trinity Highway Customer Service Department for exact panel requirements of your application.

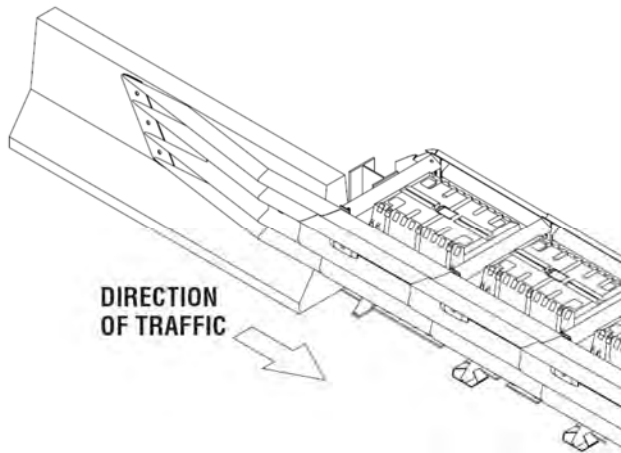


Figure 8
Quad-Beam™ to Safety Barrier
(NJ shape) Transition Panel

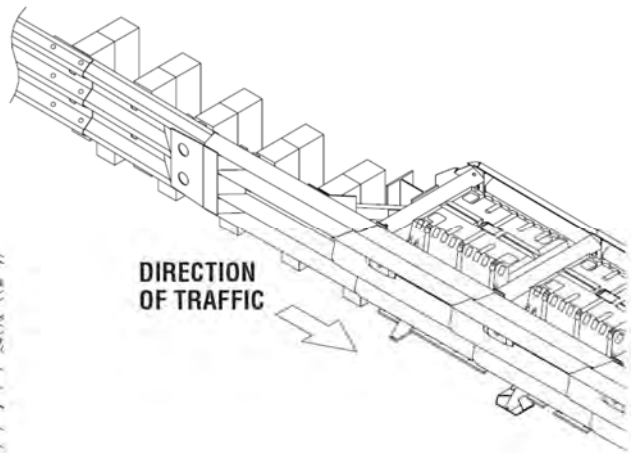


Figure 9
Quad-Beam™ to Thrie-Beam
Transition Panel

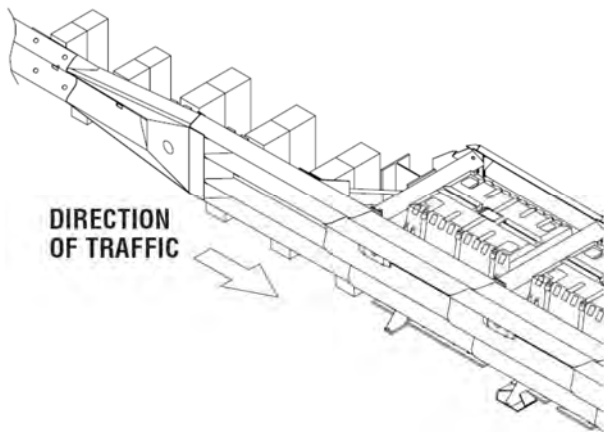


Figure 10
Quad-Beam™ to W-Beam
Transition Panel

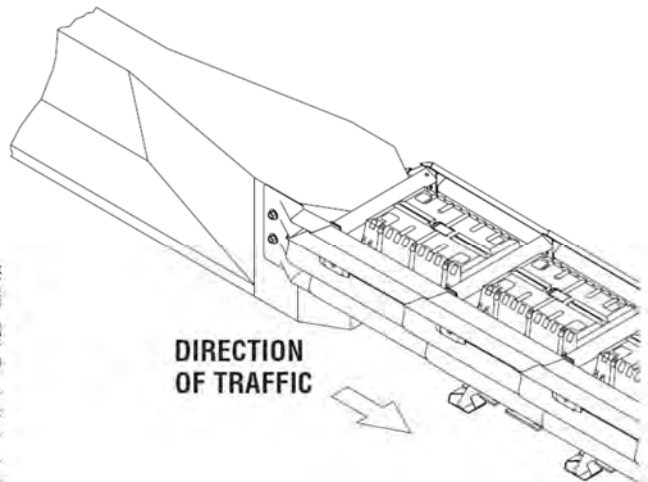


Figure 11
Quad-Beam™ End Shoe
Transition Panel

QuadGuard® II CZ Deployment Criteria

This portable compact crash cushion is for construction zones. The QuadGuard® II CZ is available in the same narrow sizes as permanent systems.

The QuadGuard® II CZ must be properly anchored.



Important: QuadGuard® II wide systems should not be anchored to asphalt.

QuadGuard® II CZ Plate Model Numbers and Widths			
Number of Bays	610 mm [24"]	760 mm [30"]	915 mm [36"]
2	QZ27024P	QZ27030P	QZ27036P
5	QZ210024P	QZ210030P	QZ210036P

Model Number Description

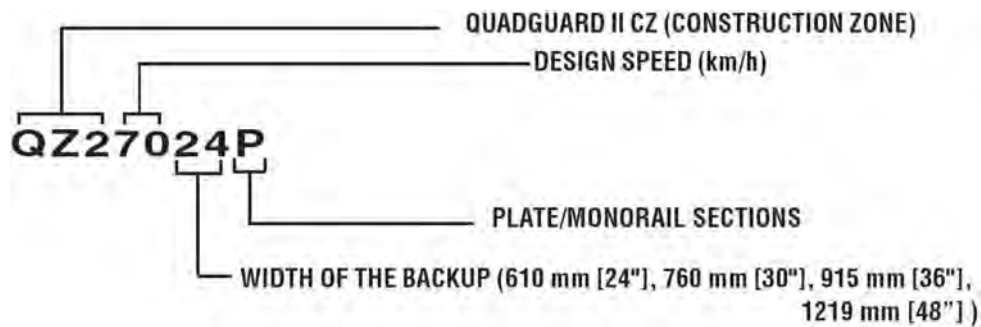


Figure 12
Model Number Key

Foundation/Anchoring



Warning: It is the responsibility of the installer that this assembly conforms with the guidance provided by the AASHTO Roadside Design Guide, including, but not limited to, those regarding placement on or adjacent to curbs.

Asphalt Installations

Systems with a Tension-Strut Backup may be temporarily installed in construction zones on asphalt. Assemblies on **Asphalt Concrete (“A.C.”)** must provide a minimum of 76 mm [3”] layer of asphalt over a minimum of 76 mm [3”] layer of **Portland Cement Concrete (“P.C.C.”)**, 152 mm [6”] layer of asphalt over 152 mm [6”] layer of subbase, or 203 mm [8”] layer of asphalt with no subbase.



Important: Only 460 mm [18”] threaded rods, utilizing Trinity Highway approved adhesive, can be used with **asphalt** foundations. Contact Trinity Highway for a complete list of approved adhesives (p. 3).

Concrete Installations

For concrete installations, the QuadGuard® II should be installed only on an existing or freshly placed and cured concrete base (28 MPa [4000 psi] minimum). Orientation of the concrete base and the attenuator must comply with the project plans or as otherwise determined by the resident project engineer or appropriate highway authority.

Recommended dimension and reinforcement specifications for new concrete pads can be found on the standard drawings.

The QuadGuard® II may be installed on any of the following foundations using the specified anchorage:

Foundation A: Reinforced Concrete Pad or Roadway

Foundation: 150 mm [6”] minimum depth P.C.C.

Anchorage: Approved adhesive with 180 mm [7”] studs 140 mm [5 1/2”] embedment

Foundation B: Asphalt over P.C.C.

Foundation: 76 mm [3”] minimum asphalt concrete (A.C.) over 76 mm [3”] minimum P.C.C.

Anchorage: Length of anchor required is 460 mm [18”] 420 mm [16 1/2”] embedment

Foundation C: Asphalt over Subbase

Foundation: 150 mm [6”] minimum A.C. over 150 mm [6”] minimum Compacted Subbase (C.S.)

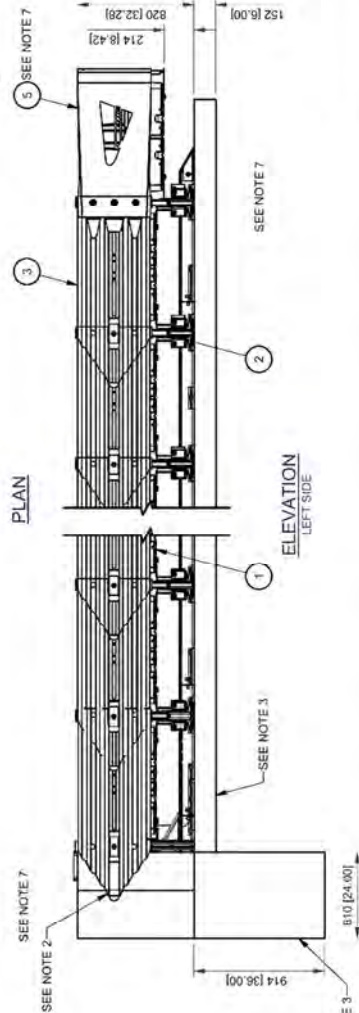
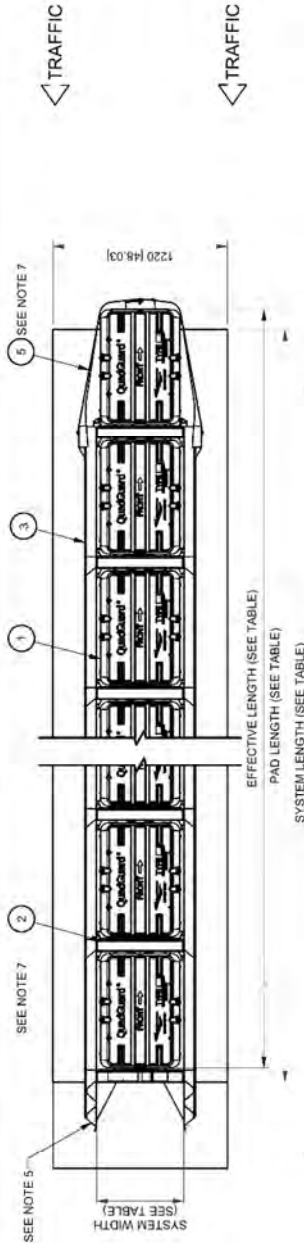
Anchorage: Approved adhesive with 460 mm [18”] studs 420 mm [16 1/2”] embedment

Foundation D: Asphalt Only

Foundation: 200 mm [8”] minimum A.C.

Anchorage: Approved adhesive with 460 mm [18”] studs - 420 mm [16 1/2”] embedment

QG2CBCVR-U



- NOTES:
1. IN COMPLIANCE WITH THE AASHTO 2011 ROADSIDE DESIGN GUIDE, THIS SYSTEM IS DESIGNED TO PROVIDE IMPACT RESISTANCE AND ISLANDS TO ENSURE PROPER IMPACT PERFORMANCE.
 2. PROVISION SHALL BE MADE FOR REAR FENDER PANELS TO SLIDE REARWARD UPON IMPACT 762 (30.00) MIN.
 3. 15016.00) MIN. REINFORCED MPa (6000 PSI) P.C. CONCRETE SHALL BE USED FOR THE CONCRETE BACKUP. THE CONCRETE SHALL BE P.C. CONCRETE ROADWAY, MEASURING AT LEAST (3.66 m) [(12'-07") WIDE BY 15.24 m (50'-07") LONG. ANCHOR BLOCK IS NOT REQUIRED WHEN USING 8" CONCRETE PAD INSTALLED AGAINST AN IMMOVABLE STRUCTURE SUCH AS A CONCRETE WALL OR ABUTMENT.
 4. SEE THE "QUADGUARD II SYSTEM PRODUCT MANUAL" FOR A DESCRIPTION OF ITS IMPACT PERFORMANCE CHARACTERISTICS AND DESIGN LIMITATIONS BEFORE PLACING A SYSTEM AT A GIVEN SITE. INFORMATION AND COPIES OF ABOVE MANUAL ARE AVAILABLE BY CALLING CUSTOMER SERVICE DEPARTMENT AT (888) 325-6374.
 5. WHERE NECESSARY, THE CUSTOMER SHALL SUPPLY AN ADEQUATE TRANSITION FROM THE QUADGUARD II SYSTEM TO THE OBJECT BEING SHIELDED.
 6. UNITS OF MEASUREMENT ARE MILLIMETERS (INCHES) UNLESS OTHERWISE NOTED.
 7. BACKUP, MONORAL, AND NOSE ASSEMBLIES ARE NOT INCLUDED IN MODEL NUMBER, ORDER SEPARATELY.
 8. THE QUADGUARD II HAS BEEN FULLY TESTED TO NCHRP 350.

* SYSTEM CAPACITY ESTIMATED THROUGH CALCULATION

BAYS	610 (24") WIDTH	762 (30") WIDTH	914 (36") WIDTH	1220 (48") WIDTH	EFFECTIVE LENGTH	PAD LENGTH	MAX DESIGN SPEED	NO. OF CARTRIDGES	
	MODEL NO.	MODEL NO.	MODEL NO.	MODEL NO.	m	ft/in	km/h	TYPE I	TYPE II
1*	QG24024	QG24030	QG24036	QG24043	1.73 [5'-8"]	1.68 [5'-6"]	40 [25]	2	0
2	QG27024	QG27030	QG27036	QG27043	2.52 [8'-3"]	2.59 [8'-6"]	70 [43]	2	1
3*	QG28024	QG28030	QG28036	QG28043	3.43 [11'-3"]	3.51 [11'-5"]	80 [50]	2	2
4*	QG29024	QG29030	QG29036	QG29043	4.34 [14'-3"]	4.42 [14'-5"]	90 [60]	3	2
5	QG210024	QG210030	QG210036	QG210043	5.26 [17'-3"]	5.33 [17'-5"]	100 [62]	3	3

REFERENCES

DIAPHRAGM ASSY.	602850
DIAPHRAGM SHIM KIT	61065
NOSE ASSY.	611540
FENDER PANEL ASSY.	609236
BACKUP ASSY.	35-40-08 604507
MONORAL ASSY.	611367
CONCRETE PAD	35-40-09

KEY

1 CARTRIDGE	4 MONORAL
2 DIAPHRAGM	5 NOSE ASSEMBLY
3 FENDER PANEL	6 BACKUP

SERIAL NO.	
SALES ORDER	
EH PROJECT	
DESIGN SPEED	SEE TABLE
NOSE TYPE	
NO. OF UNITS	

DATE	3/31/2009
BY	D. Kohfeld
CHECKED	R. Broughtner
DATE	4/21/2006
DESCRIPTION	QG2CBCVR-U (w)
DO NOT SCALE DRAWING	

UNIDIRECTIONAL

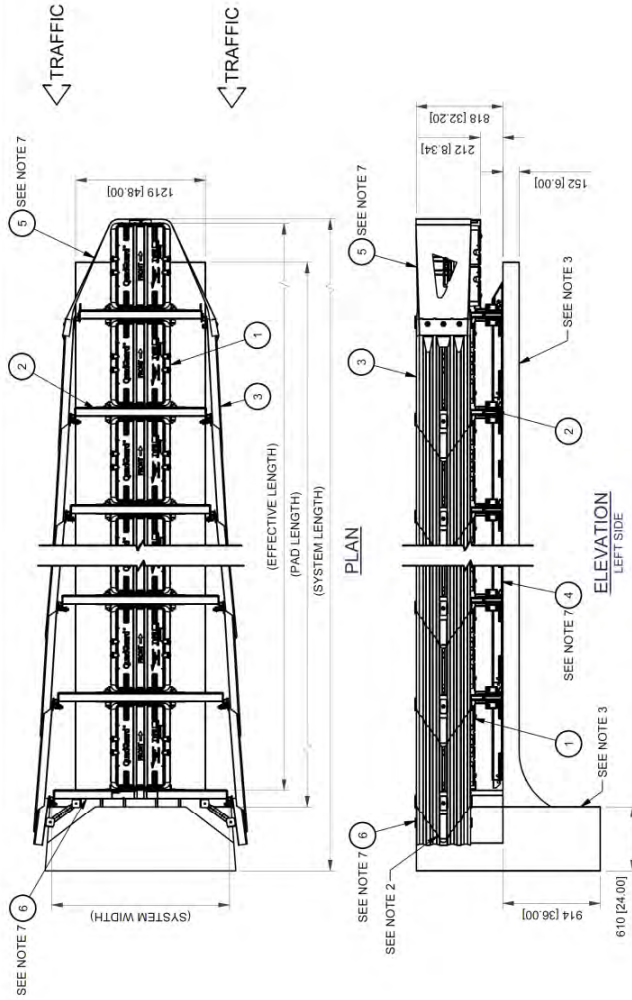
QUADGUARD® II SYSTEM
WITH CONCRETE BACKUP

PROJECT: QG2CBCVR-U

DATE: 1 of 1

QuadGuard® II w/Concrete Backup

QF2CBCVR-U



- NOTES:**
1. IN COMPLIANCE WITH THE AASHTO 2011 ROADSIDE DESIGN GUIDE, MANUFACTURER RECOMMENDS REMOVAL OF ALL CURBS AND ISLANDS TO ENSURE PROPER IMPACT PERFORMANCE.
 2. MONORAIL SHALL BE 28MPa (4000 PSI) P.C. CONCRETE PAD OR 200 (8.00) MIN. NON-REINFORCED.
 3. 50 (6.00) MIN. REINFORCED 28 MPa (4000 PSI) P.C. CONCRETE PAD OR 200 (8.00) MIN. NON-REINFORCED.
 4. 28MPa (4000 PSI) P.C. CONCRETE ROADWAY, MEASURING AT LEAST 3.66 m (12'-0") WIDE BY 15.24 m (50'-0") LONG. ANCHOR BLOCK IS NOT REQUIRED WHEN USING 8" CONCRETE PAD INSTALLED AGAINST AN IMMovable STRUCTURE SUCH AS A CONCRETE WALL OR ABUTMENT.
 5. SEE THE QUADGUARD II SYSTEM PRODUCT MANUAL FOR A DESCRIPTION OF ITS IMPACT PERFORMANCE CHARACTERISTICS AND DESIGN LIMITATIONS BEFORE PLACING A SYSTEM AT A GIVEN SITE. INFORMATION IS PROVIDED FOR YOUR INFORMATION ONLY. THE CUSTOMER SHALL VERIFY AN ADEQUATE TRANSITION FROM THE QUADGUARD II SYSTEM TO THE OBJECT BEING SHIELDED.
 6. UNITS OF MEASUREMENT ARE MILLIMETERS (INCHES) UNLESS OTHERWISE NOTED.
 7. BACKUP, MONORAIL AND NOSE ASSEMBLIES ARE NOT INCLUDED IN MODEL NUMBER, ORDER SEPARATELY.
 8. THE QUADGUARD II FAMILY HAS BEEN FULLY TESTED TO NCHRP 350.

*** SYSTEM CAPACITY ESTIMATED THROUGH CALCULATION**

BAYS	1753 (69") WIDTH	2285 (90") WIDTH	SYSTEM LENGTH	EFFECTIVE LENGTH	PAD LENGTH	MAX DESIGN SPEED	NO. OF CARTRIDGES
	MODEL #	MODEL #	m / ft	m / ft	m / ft	Kmph / MPH	TYPE I / TYPE II
3	CG27069	4.54 [14'-3"]	3.56 [11'-8"]	3.51 [11'-5"]	70 [43]	2	2
4*	CG28069	5.26 [17'-3"]	4.47 [14'-6"]	4.42 [14'-5"]	80 [50]	3	2
5	CG21069	6.17 [20'-3"]	5.38 [17'-6"]	5.33 [17'-5"]	100 [62]	3	3

REFERENCES

SERIAL NO.	DESCRIPTION
607173	DIAPHRAGM ASSY.
614050	DIAPHRAGM SHIM KIT
611583	NOSE ASSY.
609241	FENDER PANEL ASSY.
604513	BACKUP ASSY.
35-40-06	MONORAIL ASSY.
35-40-11	CONCRETE PAD

KEY

①	QUADGUARD CARTRIDGE
②	DIAPHRAGM
③	FENDER PANEL
④	MONORAIL
⑤	NOSE ASSEMBLY
⑥	BACKUP

REVISIONS

NO.	DATE	DESCRIPTION
1	4/6/2009	ISSUE FOR CONSTRUCTION
2	4/15/2009	REVISED TO ADD SHIM KIT (35-40-11)

DESIGNED BY: M. BUEHLER
 DRAWING SCALE: AS SHOWN
 FILE NAME: QF2CBCVR-U.dwg
 DO NOT SCALE DRAWING
 UNLESS OTHERWISE SPECIFIED

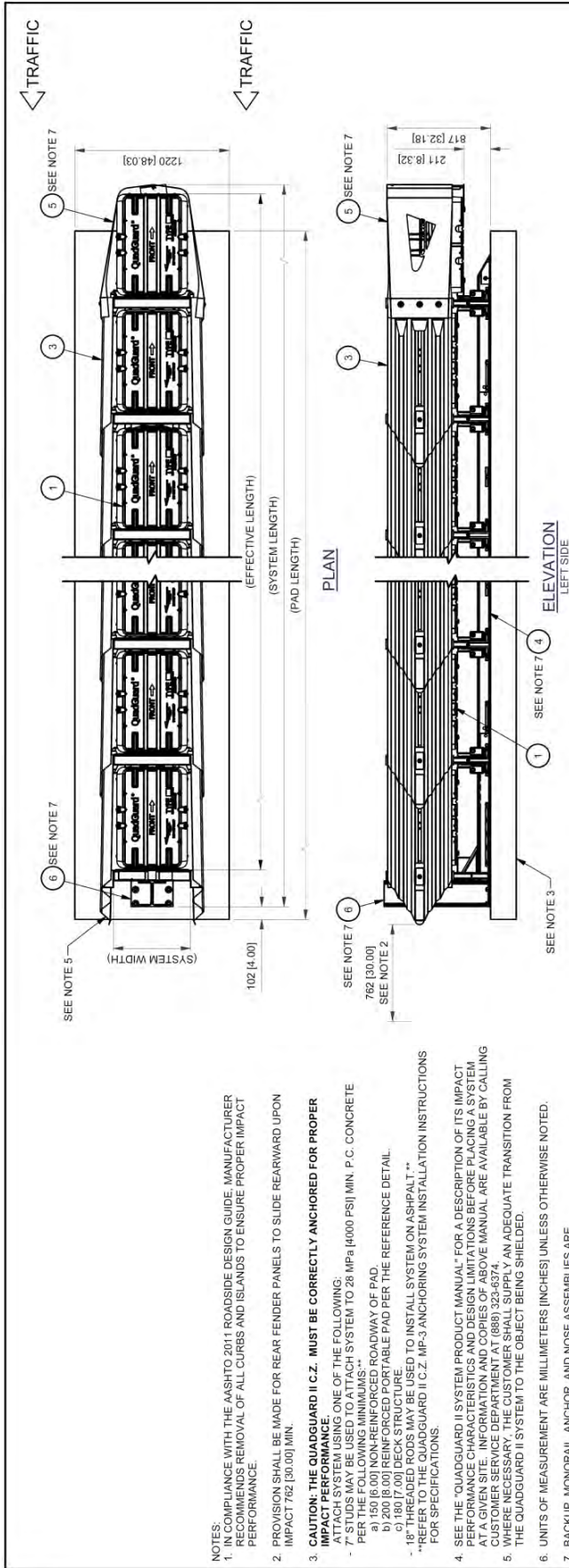
UNIDIRECTIONAL

QUADGUARD® II SYSTEM
WITH CONCRETE BACKUP

TRINITY HIGHWAY

1 of 1

QG2CZCVR-U

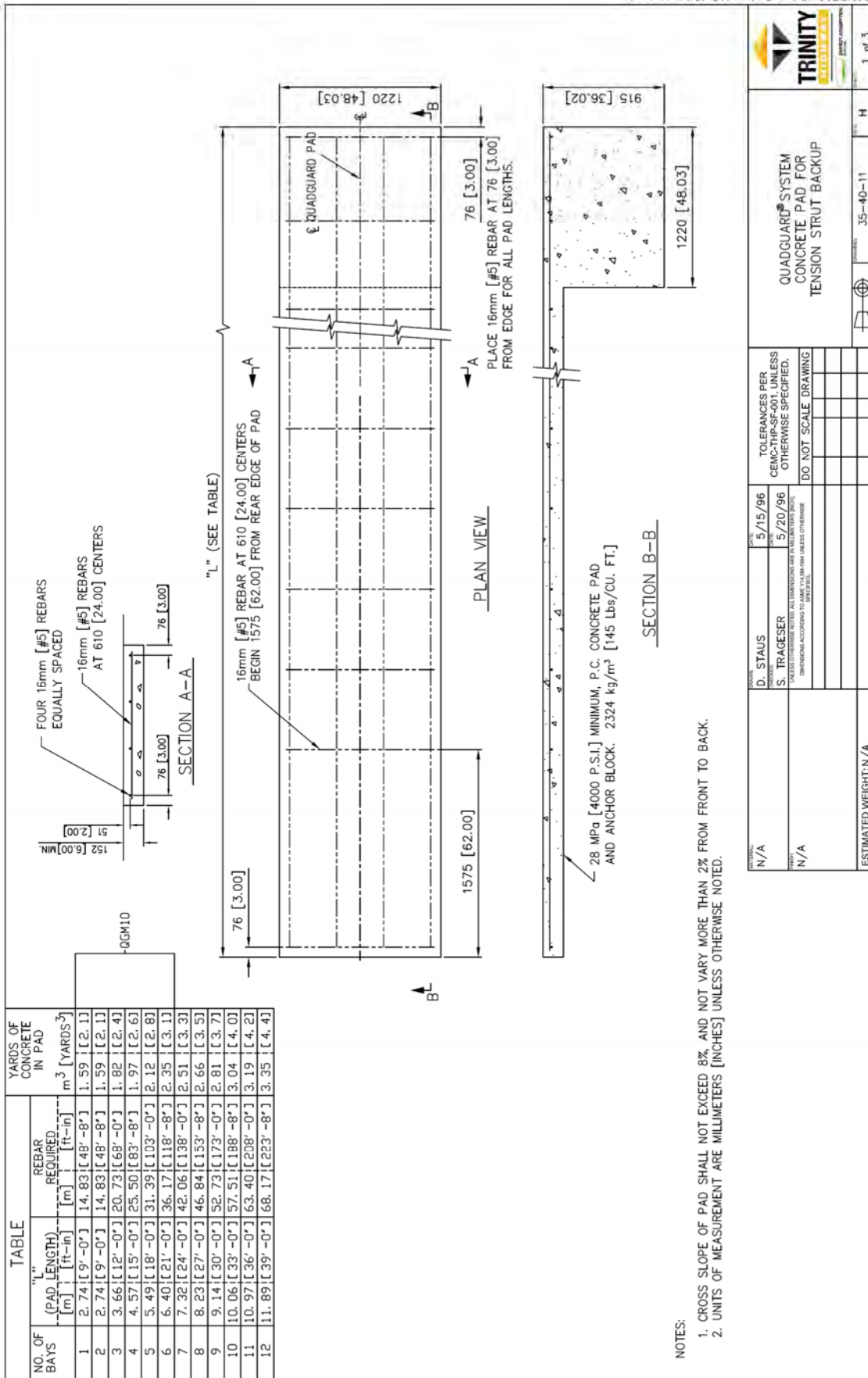


- NOTES:
- IN COMPLIANCE WITH THE AASHTO 2011 ROADSIDE DESIGN GUIDE, MANUFACTURER RECOMMENDS REMOVAL OF ALL CURBS AND ISLANDS TO ENSURE PROPER IMPACT PERFORMANCE.
 - PROVISION SHALL BE MADE FOR REAR FENDER PANELS TO SLIDE REARWARD UPON IMPACT 762 [30.00] MIN.
 - CAUTION: THE QUADGUARD II C.Z. MUST BE CORRECTLY ANCHORED FOR PROPER IMPACT PERFORMANCE.**
ATTACH SYSTEM USING ONE OF THE FOLLOWING:
- 28 MPa [4050 PSI] MIN. P.C. CONCRETE PER THE FOLLOWING MINIMUMS:
a) 150 [6.00] NON-REINFORCED ROADWAY OF PAD.
b) 200 [8.00] NON-REINFORCED PORTABLE PAD PER THE REFERENCE DETAIL.
c) 180 [7.00] DECK STRUCTURE.
- 18" THREADED RODS MAY BE USED TO INSTALL SYSTEM ON ASPHALT.
- REFER TO THE QUADGUARD II C.Z. MP-3 ANCHORING SYSTEM INSTALLATION INSTRUCTIONS FOR SPECIFICATIONS.
 - SEE THE QUADGUARD II SYSTEM PRODUCT MANUAL FOR A DESCRIPTION OF ITS IMPACT PERFORMANCE CHARACTERISTICS AND DESIGN LIMITATIONS BEFORE PLACING A SYSTEM AT A GIVEN SITE. INFORMATION AND COPIES OF ABOVE MANUAL ARE AVAILABLE BY CALLING CUSTOMER SERVICE DEPARTMENT AT (888) 323-6374.
 - WHERE NECESSARY, THE CUSTOMER SHALL SUPPLY AN ADEQUATE TRANSITION FROM THE QUADGUARD II SYSTEM TO THE OBJECT BEING SHIELDED.
 - UNITS OF MEASUREMENT ARE MILLIMETERS [INCHES] UNLESS OTHERWISE NOTED.
 - BACKUP, MONORAIL, ANCHOR, AND NOSE ASSEMBLIES ARE NOT INCLUDED IN MODEL NUMBER, ORDER SEPARATELY.
 - THE QUADGUARD II HAS BEEN FULLY TESTED TO NCHRP 350.

* SYSTEM CAPACITY ESTIMATED THROUGH CALCULATION.

BAYS	1	2	3	4	5
MODEL #	QG24030	QG24033	QG27030	QG28030	QG210030
MODEL #	170 [6.49]	170 [6.49]	274 [10.77]	366 [14.37]	447 [17.60]
MODEL #	213 [8.35]	213 [8.35]	305 [11.99]	396 [15.59]	477 [18.78]
MODEL #	264 [10.37]	264 [10.37]	356 [13.99]	447 [17.60]	528 [20.79]
MODEL #	305 [11.99]	305 [11.99]	396 [15.59]	487 [19.19]	568 [22.35]
MODEL #	346 [13.61]	346 [13.61]	437 [17.20]	528 [20.79]	609 [23.95]
MODEL #	387 [15.23]	387 [15.23]	478 [18.82]	569 [22.35]	650 [25.58]
MODEL #	428 [16.85]	428 [16.85]	519 [20.43]	610 [23.95]	691 [27.19]
MODEL #	469 [18.47]	469 [18.47]	560 [22.04]	651 [25.58]	732 [28.77]
MODEL #	510 [20.09]	510 [20.09]	601 [23.65]	692 [27.19]	773 [30.39]
MODEL #	551 [21.71]	551 [21.71]	642 [25.26]	733 [28.77]	814 [31.99]
MODEL #	592 [23.33]	592 [23.33]	683 [26.87]	774 [30.39]	855 [33.61]
MODEL #	633 [24.94]	633 [24.94]	724 [28.48]	815 [31.99]	896 [35.23]
MODEL #	674 [26.56]	674 [26.56]	765 [30.09]	856 [33.61]	937 [36.84]
MODEL #	715 [28.17]	715 [28.17]	806 [31.71]	897 [35.23]	978 [38.46]
MODEL #	756 [29.79]	756 [29.79]	847 [33.32]	938 [36.84]	1019 [40.07]
MODEL #	797 [31.41]	797 [31.41]	888 [34.93]	979 [38.46]	1060 [41.68]
MODEL #	838 [33.03]	838 [33.03]	929 [36.54]	1020 [40.07]	1101 [43.29]
MODEL #	879 [34.65]	879 [34.65]	970 [38.15]	1061 [41.68]	1142 [44.90]
MODEL #	920 [36.27]	920 [36.27]	1011 [39.76]	1102 [43.29]	1183 [46.51]
MODEL #	961 [37.88]	961 [37.88]	1052 [41.37]	1143 [44.90]	1224 [48.12]
MODEL #	1002 [39.50]	1002 [39.50]	1093 [42.98]	1184 [46.51]	1265 [49.73]
MODEL #	1043 [41.12]	1043 [41.12]	1134 [44.59]	1225 [48.12]	1306 [51.34]
MODEL #	1084 [42.74]	1084 [42.74]	1175 [46.20]	1266 [49.73]	1347 [52.95]
MODEL #	1125 [44.36]	1125 [44.36]	1216 [47.81]	1307 [51.34]	1388 [54.56]
MODEL #	1166 [45.98]	1166 [45.98]	1257 [49.42]	1348 [52.95]	1429 [56.17]
MODEL #	1207 [47.60]	1207 [47.60]	1298 [51.03]	1389 [54.56]	1470 [57.78]
MODEL #	1248 [49.22]	1248 [49.22]	1339 [52.64]	1430 [56.17]	1511 [59.39]
MODEL #	1289 [50.84]	1289 [50.84]	1380 [54.25]	1471 [57.78]	1552 [61.00]
MODEL #	1330 [52.46]	1330 [52.46]	1421 [55.86]	1512 [59.39]	1593 [62.61]
MODEL #	1371 [54.08]	1371 [54.08]	1462 [57.47]	1553 [61.00]	1634 [64.22]
MODEL #	1412 [55.70]	1412 [55.70]	1503 [59.08]	1594 [62.61]	1675 [65.83]
MODEL #	1453 [57.32]	1453 [57.32]	1544 [60.69]	1635 [64.22]	1716 [67.44]
MODEL #	1494 [58.94]	1494 [58.94]	1585 [62.30]	1676 [65.83]	1757 [69.05]
MODEL #	1535 [60.56]	1535 [60.56]	1626 [63.91]	1717 [67.44]	1798 [70.66]
MODEL #	1576 [62.18]	1576 [62.18]	1667 [65.52]	1758 [69.05]	1839 [72.27]
MODEL #	1617 [63.80]	1617 [63.80]	1708 [67.13]	1799 [70.66]	1880 [73.88]
MODEL #	1658 [65.42]	1658 [65.42]	1749 [68.74]	1840 [72.27]	1921 [75.49]
MODEL #	1699 [67.04]	1699 [67.04]	1790 [70.35]	1881 [73.88]	1962 [77.10]
MODEL #	1740 [68.66]	1740 [68.66]	1831 [71.96]	1922 [75.49]	2003 [78.71]
MODEL #	1781 [70.28]	1781 [70.28]	1872 [73.57]	1963 [77.10]	2044 [80.32]
MODEL #	1822 [71.90]	1822 [71.90]	1913 [75.18]	2004 [78.71]	2085 [81.93]
MODEL #	1863 [73.52]	1863 [73.52]	1954 [76.79]	2045 [80.32]	2126 [83.54]
MODEL #	1904 [75.14]	1904 [75.14]	1995 [78.40]	2086 [81.93]	2167 [85.15]
MODEL #	1945 [76.76]	1945 [76.76]	2036 [80.01]	2127 [83.54]	2208 [86.76]
MODEL #	1986 [78.38]	1986 [78.38]	2077 [81.62]	2168 [85.15]	2249 [88.37]
MODEL #	2027 [80.00]	2027 [80.00]	2118 [83.23]	2209 [86.76]	2290 [89.98]
MODEL #	2068 [81.62]	2068 [81.62]	2159 [84.84]	2250 [88.37]	2331 [91.59]
MODEL #	2109 [83.24]	2109 [83.24]	2200 [86.45]	2291 [89.98]	2372 [93.20]
MODEL #	2150 [84.86]	2150 [84.86]	2241 [88.06]	2332 [91.59]	2413 [94.81]
MODEL #	2191 [86.48]	2191 [86.48]	2282 [89.67]	2373 [93.20]	2454 [96.42]
MODEL #	2232 [88.10]	2232 [88.10]	2323 [91.28]	2414 [94.81]	2495 [98.03]
MODEL #	2273 [89.72]	2273 [89.72]	2364 [92.89]	2455 [96.42]	2536 [99.64]
MODEL #	2314 [91.34]	2314 [91.34]	2405 [94.50]	2496 [98.03]	2577 [101.25]
MODEL #	2355 [92.96]	2355 [92.96]	2446 [96.11]	2537 [99.64]	2618 [102.86]
MODEL #	2396 [94.58]	2396 [94.58]	2487 [97.72]	2578 [101.25]	2659 [104.47]
MODEL #	2437 [96.20]	2437 [96.20]	2528 [99.33]	2619 [102.86]	2700 [106.08]
MODEL #	2478 [97.82]	2478 [97.82]	2569 [100.94]	2660 [104.47]	2741 [107.69]
MODEL #	2519 [99.44]	2519 [99.44]	2610 [102.55]	2701 [106.08]	2782 [109.30]
MODEL #	2560 [101.06]	2560 [101.06]	2651 [104.16]	2742 [107.69]	2823 [110.91]
MODEL #	2601 [102.68]	2601 [102.68]	2692 [105.77]	2783 [109.30]	2864 [112.52]
MODEL #	2642 [104.30]	2642 [104.30]	2733 [107.38]	2824 [110.91]	2905 [114.13]
MODEL #	2683 [105.92]	2683 [105.92]	2774 [108.99]	2865 [112.52]	2946 [115.74]
MODEL #	2724 [107.54]	2724 [107.54]	2815 [110.60]	2906 [114.13]	2987 [117.35]
MODEL #	2765 [109.16]	2765 [109.16]	2856 [112.21]	2947 [115.74]	3028 [118.96]
MODEL #	2806 [110.78]	2806 [110.78]	2897 [113.82]	2988 [117.35]	3069 [120.57]
MODEL #	2847 [112.40]	2847 [112.40]	2938 [115.43]	3029 [118.96]	3110 [122.18]
MODEL #	2888 [114.02]	2888 [114.02]	2979 [117.04]	3070 [120.57]	3151 [123.79]
MODEL #	2929 [115.64]	2929 [115.64]	3020 [118.65]	3111 [122.18]	3192 [125.40]
MODEL #	2970 [117.26]	2970 [117.26]	3061 [120.26]	3152 [123.79]	3233 [127.01]
MODEL #	3011 [118.88]	3011 [118.88]	3102 [121.87]	3193 [125.40]	3274 [128.62]
MODEL #	3052 [120.50]	3052 [120.50]	3143 [123.48]	3234 [127.01]	3315 [130.23]
MODEL #	3093 [122.12]	3093 [122.12]	3184 [125.09]	3275 [128.62]	3356 [131.84]
MODEL #	3134 [123.74]	3134 [123.74]	3225 [126.70]	3316 [130.23]	3397 [133.45]
MODEL #	3175 [125.36]	3175 [125.36]	3266 [128.31]	3357 [131.84]	3438 [135.06]
MODEL #	3216 [126.98]	3216 [126.98]	3307 [129.92]	3398 [133.45]	3479 [136.67]
MODEL #	3257 [128.60]	3257 [128.60]	3348 [131.53]	3439 [135.06]	3520 [138.28]
MODEL #	3298 [130.22]	3298 [130.22]	3389 [133.14]	3480 [136.67]	3561 [139.89]
MODEL #	3339 [131.84]	3339 [131.84]	3430 [134.75]	3521 [138.28]	3602 [141.50]
MODEL #	3380 [133.46]	3380 [133.46]	3471 [136.36]	3562 [139.89]	3643 [143.11]
MODEL #	3421 [135.08]	3421 [135.08]	3512 [137.97]	3603 [141.50]	3684 [144.72]
MODEL #	3462 [136.70]	3462 [136.70]	3553 [139.58]	3644 [143.11]	3725 [146.33]
MODEL #	3503 [138.32]	3503 [138.32]	3594 [141.19]	3685 [144.72]	3766 [147.94]
MODEL #	3544 [139.94]	3544 [139.94]	3635 [142.80]	3726 [146.33]	3807 [149.55]
MODEL #	3585 [141.56]	3585 [141.56]	3676 [144.41]	3767 [147.94]	3848 [151.16]
MODEL #	3626 [143.18]	3626 [143.18]	3717 [146.02]	3808 [149.55]	3889 [152.77]
MODEL #	3667 [144.80]	3667 [144.80]	3758 [147.63]	3849 [151.16]	3930 [154.38]
MODEL #	3708 [146.42]	3708 [146.42]	3799 [149.24]	3890 [152.77]	3971 [155.99]
MODEL #	3749 [148.04]	3749 [148.04]	3840 [150.85]	3931 [154.38]	4012 [157.60]
MODEL #	3790 [149.66]	3790 [149.66]	3881 [152.46]	3972 [155.99]	4053 [159.21]
MODEL #	3831 [151.28]	3831 [151.28]	3922 [154.07]	4013 [157.60]	4094 [160.82]
MODEL #	3872 [152.90]	3872 [152.90]	3963 [155.68]	4054 [159.21]	4135 [162.43]
MODEL #	3913 [154.52]	3913 [154.52]	4004 [157.29]	4095 [160.82]	4176 [164.04]
MODEL #	3954 [156.14]	3954 [156.14]	4045 [158.90]	4136 [162.43]	4217 [165.65]
MODEL #	3995 [157.76]	3995 [157.76]	4086 [160.51]	4177 [164.04]	4258 [167.26]
MODEL #	4036 [159.38]	4036 [159.38]	4127 [162.12]	4218 [165.65]	4299 [168.87]
MODEL #	4077 [161.00]	4077 [161.00]	4168 [163.73]	4259 [167.26]	4340 [170.48]
MODEL #	4118 [162.62]	4118 [162.62]	4209 [165.34]	4300 [168.87]	4381 [172.09]
MODEL #	4159 [164.24]	4159 [164.24]	4250 [166.95]	4341 [170.48]	4422 [173.70]
MODEL #	4200 [165.86]	4200 [165.86]	4291 [168.56]	4382 [172.09]	4463 [175.31]
MODEL #	4241 [167.48]	4241 [167.48]	4332 [170.17]	4423 [173.70]	4504 [176.92]
MODEL #	4282 [169.10]	4282 [169.10]	4373 [171.78]	4464 [175.31]	4545 [178.53]
MODEL #	4323 [170.72]	4323 [170.72]	4414 [173.39]	4505 [176.92]	4586 [180.14]
MODEL #	4364 [172.34]	4364 [172.34]	4455 [175.00]	4546 [178.53]	4627 [181.75]
MODEL #	4405 [173.96]	4405 [173.96]	4496 [176.61]	4587 [180.14]	4668 [183.36]
MODEL #	4446 [175.58]	4446 [175.58]	4537 [178.22]	4628 [181.75]	4709 [184.97]
MODEL #	4487 [177.20]	4487 [177.20]	4578 [179.83]	4669 [183.36]	4750 [186.58]
MODEL #	4528 [178.82]	4528 [178.82]	4619 [181.44]	4710 [184.97]	4791 [188.19]
MODEL #	4569 [180.44]	4569 [180.44]	4660 [183.05]	4751 [186.58]	4832 [189.80]
MODEL #	4610 [182.06]	4610 [182.06]	4701 [184.66]	4792 [188.19]	4873 [191.41]
MODEL #	4651 [183.68]	4651 [183.68]	4742 [186.27]	4833 [189.80]	4914 [193.02]
MODEL #	4692 [185.30]	4692 [185.30]	4783 [187.88]	4874 [191.41]	4955 [194.63]
MODEL #	4733 [186.92]	4733 [186.92]	4824 [189.49]	4915 [193.02]	4996 [196.24]
MODEL #	4774 [188.54]	4774 [188.54]	4865 [191.10]	4956 [194.63]	5037 [197.85]
MODEL #	4815 [190.16]	4815 [190.16]	4906 [192.71]	4997 [196.24]	5078 [199.46]
MODEL #	4856 [191.78]	4856 [191.78]	4947 [194.32]	5038 [197.85]	5119 [201.07]
MODEL #	4897 [193.40]	4897 [193.40]	4988 [195.93]	5079 [199.46]	5160 [202.68]
MODEL #	4938 [195.02]	4938 [195.02]	5029 [197.54]	5120 [201.07]	5201 [204.29]
MODEL #	4979 [196.64]	4979 [196.64]	5070 [199.1		

35-40-11 - 1 of 3



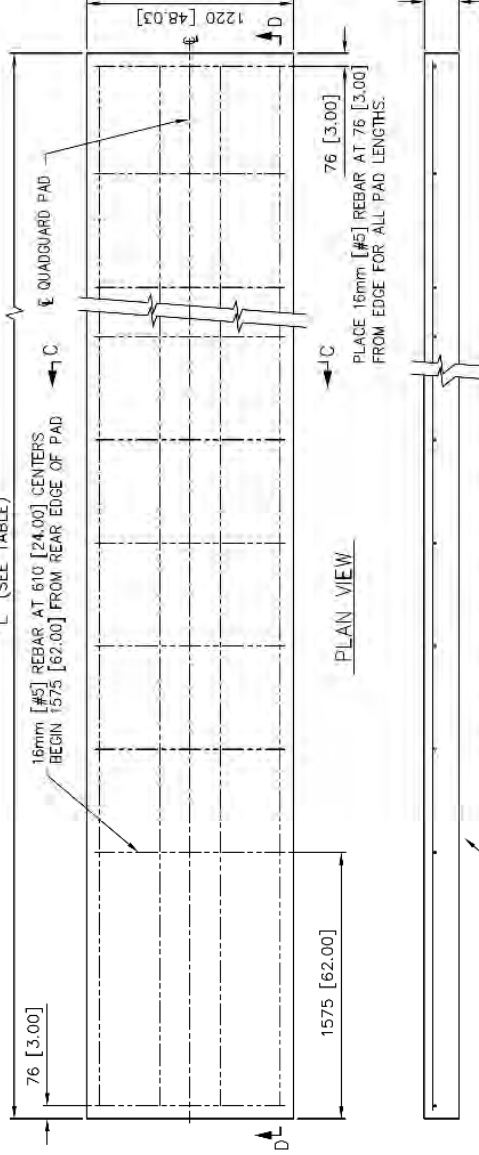
8" Concrete Pad for Tension Strut Backup

35-40-11 - 2 of 3

NO. OF BAYS	"L" (PAD LENGTH)		REBAR REQUIRED		YARDS OF CONCRETE IN PAD m ³ [YARDS ³]
	[ft-in]	[m]	[ft-in]	[m]	
1	2.74 [19'-0"]	0.83 [48'-8"]	0.7 [0.9]	0.7 [0.9]	
2	2.74 [19'-0"]	14.83 [148'-8"]	0.7 [0.9]	0.7 [0.9]	
3	3.66 [12'-0"]	20.79 [168'-0"]	0.9 [1.2]	0.9 [1.2]	
4	4.57 [15'-0"]	25.50 [183'-8"]	1.2 [1.5]	1.2 [1.5]	
5	5.49 [18'-0"]	31.39 [103'-0"]	1.4 [1.8]	1.4 [1.8]	
6	6.40 [21'-0"]	36.17 [118'-8"]	1.6 [2.1]	1.6 [2.1]	
7	7.32 [24'-0"]	42.06 [138'-0"]	1.8 [2.4]	1.8 [2.4]	
8	8.23 [27'-0"]	46.84 [153'-8"]	2.1 [2.7]	2.1 [2.7]	
9	9.14 [30'-0"]	52.79 [173'-0"]	2.3 [3.0]	2.3 [3.0]	
10	10.06 [33'-0"]	57.51 [188'-8"]	2.5 [3.3]	2.5 [3.3]	
11	10.97 [36'-0"]	63.40 [208'-0"]	2.7 [3.6]	2.7 [3.6]	
12	11.89 [39'-0"]	68.17 [223'-8"]	3.0 [3.9]	3.0 [3.9]	

OGM10

"L" (SEE TABLE)



NOTES:

1. CROSS SLOPE OF PAD SHALL NOT EXCEED 8%, AND NOT VARY MORE THAN 2% FROM FRONT TO BACK.
2. TO PREVENT SLIDING DURING AN IMPACT, PAD MUST BE INSTALLED AGAINST OR TIED TO AN EXISTING STRUCTURE. OTHERWISE ADDITIONAL BELOW GRADE SUPPORTS MUST BE ADDED AS DETERMINED NECESSARY BY THE PROJECT ENGINEER.
3. UNITS OF MEASUREMENT ARE MILLIMETERS [INCHES] UNLESS OTHERWISE NOTED.

SECTION D-D

NO. OF BAYS	N/A	DESIGNED BY	D. STAUS	DATE	5/15/96	TOLERANCES PER	CEMCO-TRIP-SF-001 UNLESS OTHERWISE SPECIFIED.
NO. OF BAYS	N/A	DESIGNED BY	S. TRAGESER	DATE	5/20/96	DO NOT SCALE DRAWING	
ESTIMATED WEIGHT: N/A							



QUADGUARD® SYSTEM OPTIONAL
8" CONCRETE PAD WITH REBAR
FOR TENSION STRUT BACKUP

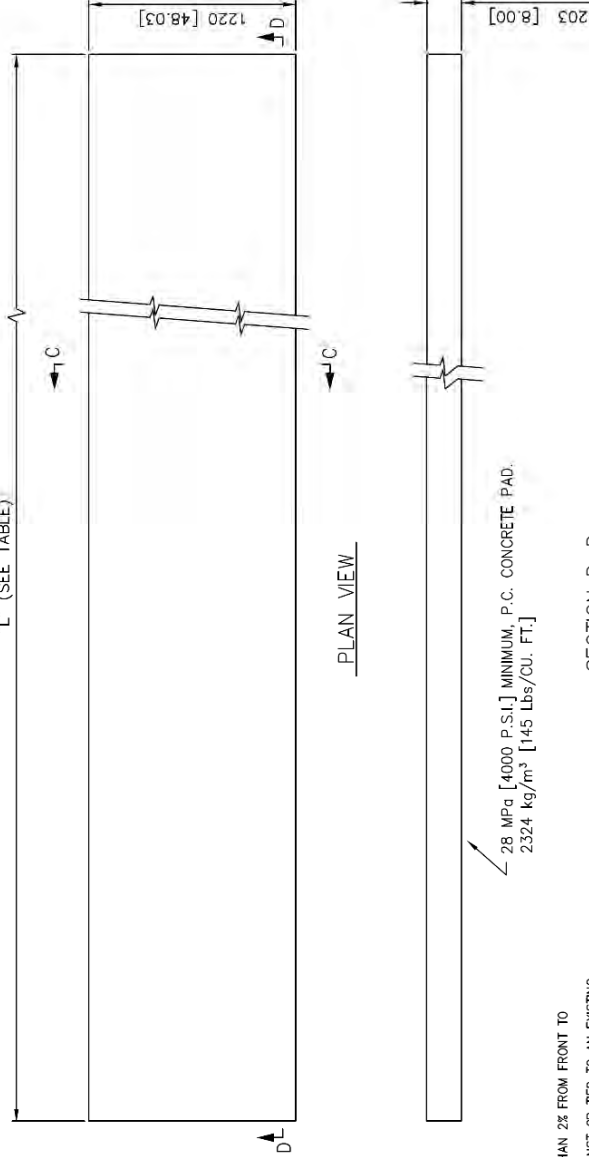
2 of 3
35-40-11

Optional 8" Concrete Pad for Tension Strut Backup

35-40-11 – 3 of 3

NO. OF BAYS	"L" (PAD LENGTH)		YARDS OF CONCRETE IN PAD m ³ [YARDS ³]
	[ft-in]	[m]	
1	2.74 [9'-0"]	0.7 [0.9]	-QGM10
2	2.74 [9'-0"]	0.7 [0.9]	
3	3.66 [12'-0"]	0.9 [1.2]	
4	4.57 [15'-0"]	1.2 [1.5]	
5	5.49 [18'-0"]	1.4 [1.8]	
6	6.40 [21'-0"]	1.6 [2.1]	
7	7.32 [24'-0"]	1.8 [2.4]	
8	8.23 [27'-0"]	2.1 [2.7]	
9	9.14 [30'-0"]	2.3 [3.0]	
10	10.06 [33'-0"]	2.5 [3.3]	
11	10.97 [36'-0"]	2.7 [3.6]	
12	11.89 [39'-0"]	3.0 [3.9]	

"L" (SEE TABLE)



PLAN VIEW

SECTION C-C

NOTES:

1. GROSS SLOPE OF PAD SHALL NOT EXCEED 8% AND NOT VARY MORE THAN 2% FROM FRONT TO BACK.
2. TO PREVENT SLIDING DURING AN IMPACT, PAD MUST BE INSTALLED AGAINST OR TIED TO AN EXISTING STRUCTURE. OTHERWISE ADDITIONAL BELOW GRADE SUPPORTS MUST BE ADDED AS DETERMINED NECESSARY BY THE PROJECT ENGINEER.
3. UNITS OF MEASUREMENT ARE MILLIMETERS [INCHES] UNLESS OTHERWISE NOTED.
4. IMPROPER CURING AND/OR EXPOSURE TO DRAMATIC TEMPERATURE CHANGES TO PREVENT CRACKING, REINFORCE PAD AS NECESSARY.

← 28 MPa [4000 P.S.I.] MINIMUM, P.C. CONCRETE PAD.
2324 kg/m³ [145 Lbs/CU. FT.]

SECTION D-D

DESIGNED BY J. SIMMONS	DATE 1/12/16	TOLERANCES PER CEMC-THP-SF-001, UNLESS OTHERWISE SPECIFIED.	QUADGUARD® SYSTEM OPTIONAL 8" CONCRETE PAD WITHOUT REBAR FOR TENSION STRUT BACKUP	SCALE 35-40-11	SHEET NO. 3 of 3
CHECKED BY R. BROUGHER	DATE 1/12/16	DO NOT SCALE DRAWING			
APPROVED BY [Signature]					
ESTIMATED WEIGHT: N/A					



Optional 8" Concrete Pad Without Rebar for Tension Strut Backup

604570

TABLE A

ASSY. NO.	STOCK NO.	DESCRIPTION	WIDTH
604570	604741	BACKUP.TS.24.OG.WITH DECALS.G	610 (24.00)
604574	604748	BACKUP.TS.30.OG.WITH DECALS.G	760 (30.00)
604584	604762	BACKUP.TS.38.OG.WITH DECALS.G	915 (38.00)
604590	604770	BACKUP.TS.46.OG.WITH DECALS	1219 (46.00)

NOTE

1. WHEN TRANSITIONING QUADGUARD SYSTEM TO EXISTING BARRIER, REFER TO THE ASSEMBLY DRAWINGS FOR PROPER USE OF SIDE PANEL. PART NO. 611868.
2. ITEM 1 SHOWN IS 604570 (24") ASSEMBLY 604574 (30") WILL NOT HAVE HOLES IN THE QUADBEAM PANEL AND HAS CARTRIDGE SUPPORT BRACKETS. ASSEMBLIES 604584 (38") AND 604590 (46") HAVE HOLES IN THE QUADBEAM PANEL, CARTRIDGE SUPPORTS, AND CHAIN-MOUNTING TABS ON THE FRONT OF THE BACKUP.

TABLE A

ITEM	STOCK NO.	DESCRIPTION	QTY.
1	SEE TABLE	BACKUP.TS.WIDTH.OG.WITH DECALS	1
2	611868	PANEL SIDE.OG	2
9	619316	ANCHOR KIT.MLT1.34X27.4)	5
10	003340	NUT.HX.5/8.G.RAIL	4
11	003400	BOLT.RAIL.5/8X2.G	4
12	605447	BRACKET.CARTRIDGE.SUPT.TS.BU.OG	1
13	611266	LOCKING BAR.CARTRIDGE.SUPT.OG	1

TABLE A

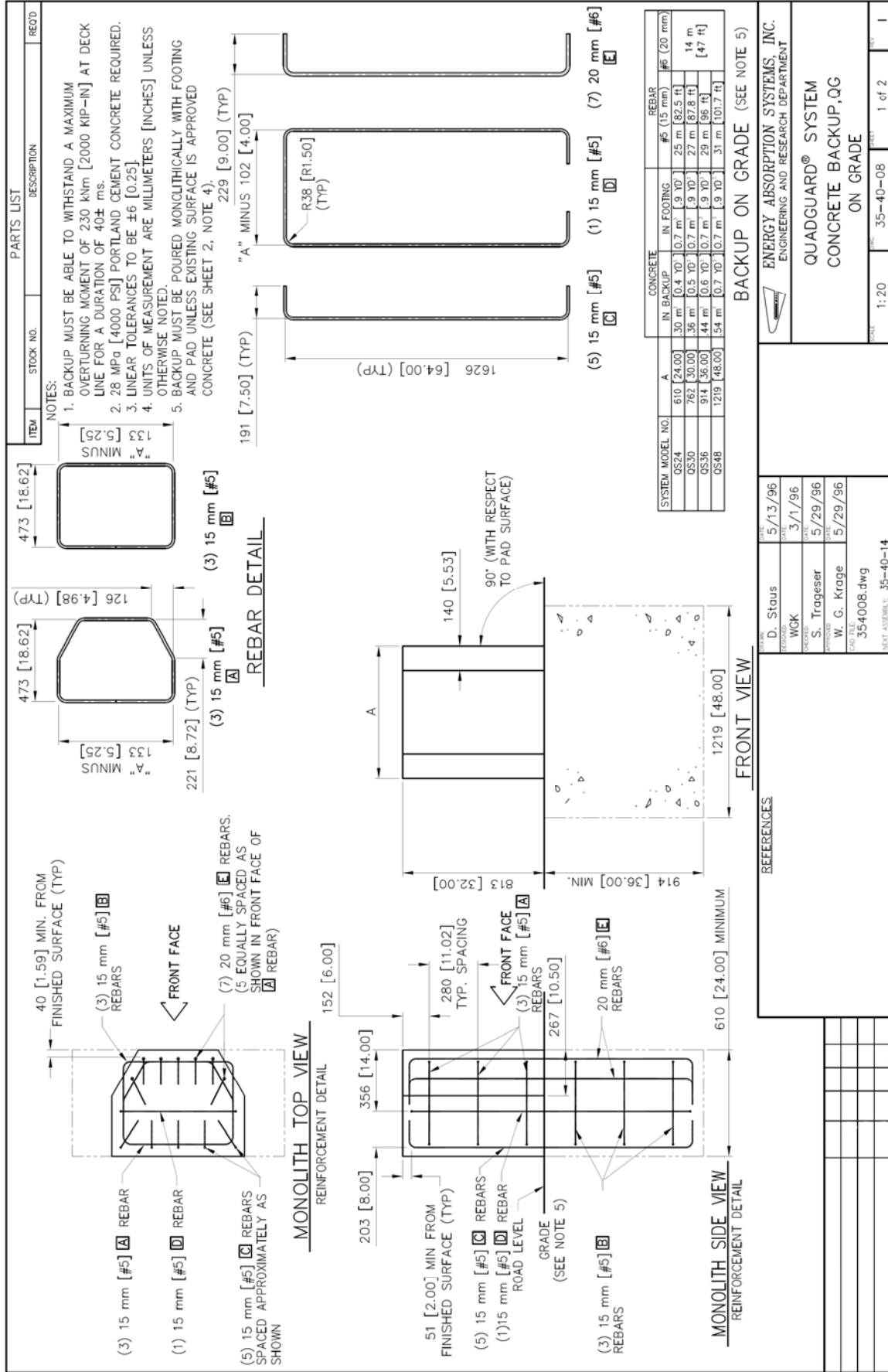
REV.	DATE	BY	DESCRIPTION
1	4/22/1998	S. LEWIS	ISSUE FOR QUADGUARD SYSTEM
2	5/15/1996	J. Machado	ISSUE FOR QUADGUARD SYSTEM

DO NOT SCALE DRAWING

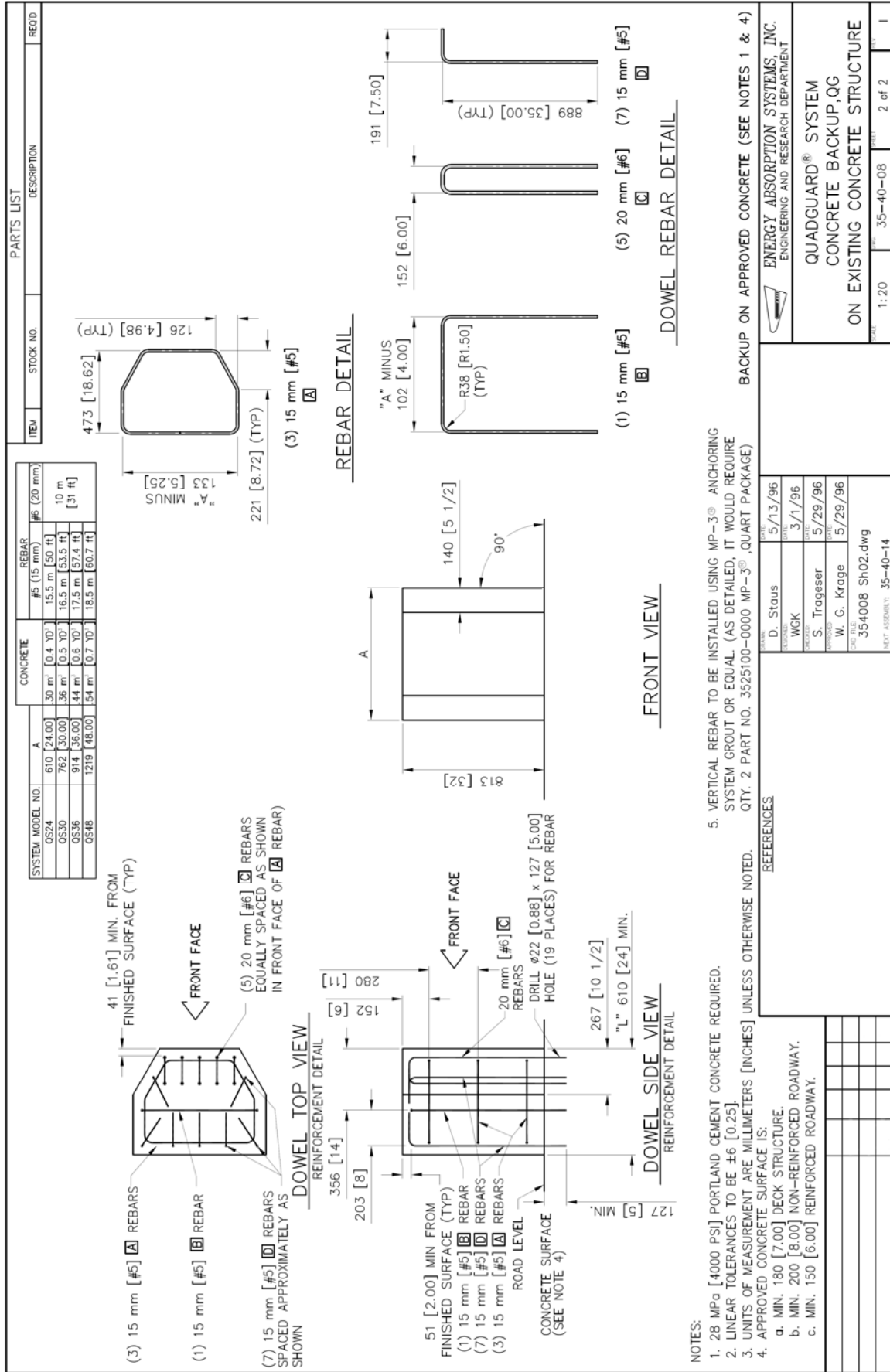
QUADGUARD® SYSTEM
BACKUP ASSY. TS. QG. 24"

TRINITY HIGHWAY

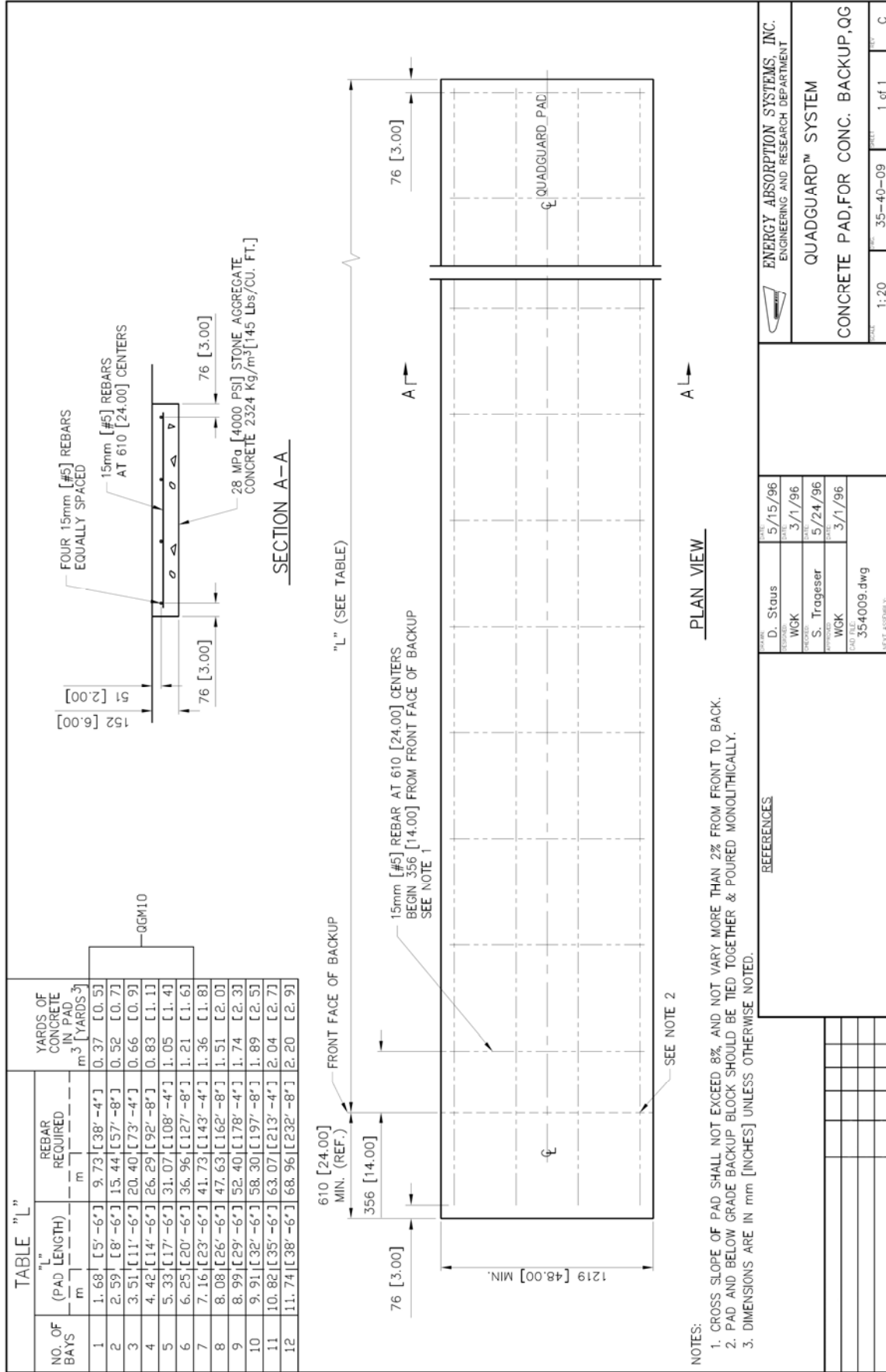
1 of 1



Concrete Backup, QG on Grade



Concrete B-up, QG on Existing Concrete Structure



Concrete Pad, for Concrete Backup, QG

ENERGY ABSORPTION SYSTEMS, INC.
ENGINEERING AND RESEARCH DEPARTMENT

QUADGUARD™ SYSTEM

CONCRETE PAD, FOR CONC. BACKUP, QG

SCALE: 1:20

PROJECT: 35-40-09

SHEET: 1 of 1

REV: C

604507

PARTS LIST			
ITEM	STOCK NO.	DESCRIPTION	QTY.
1	SEE TABLE	BACKUP CONCRETE FRONT FACE QG	1
2	619315	ANCH KIT HLT 3/4X6 1/2(4)	1
3	611988	PANEL SIDE QG	2
10	003340	NUT HX,5/8 G MAIL	4
11	003410	BOLT RAIL 5/8X2 G	4
15	619316	ANCHOR KIT HLT 1/34X7 (4)	2
16	611370	MONORAIL 1 BAY QG	1

TABLE		
ASSY NO.	ITEM 1 DESCRIPTION	WIDTH
604507	BACKUP ASSY CONCRETE 24 QG	610 (24.0)
604508	BACKUP ASSY CONCRETE 30 QG	762 (30.0)
604509	BACKUP ASSY CONCRETE 36 QG	914 (36.0)
604511	BACKUP ASSY CONCRETE 48 QG	1219 (48.0)

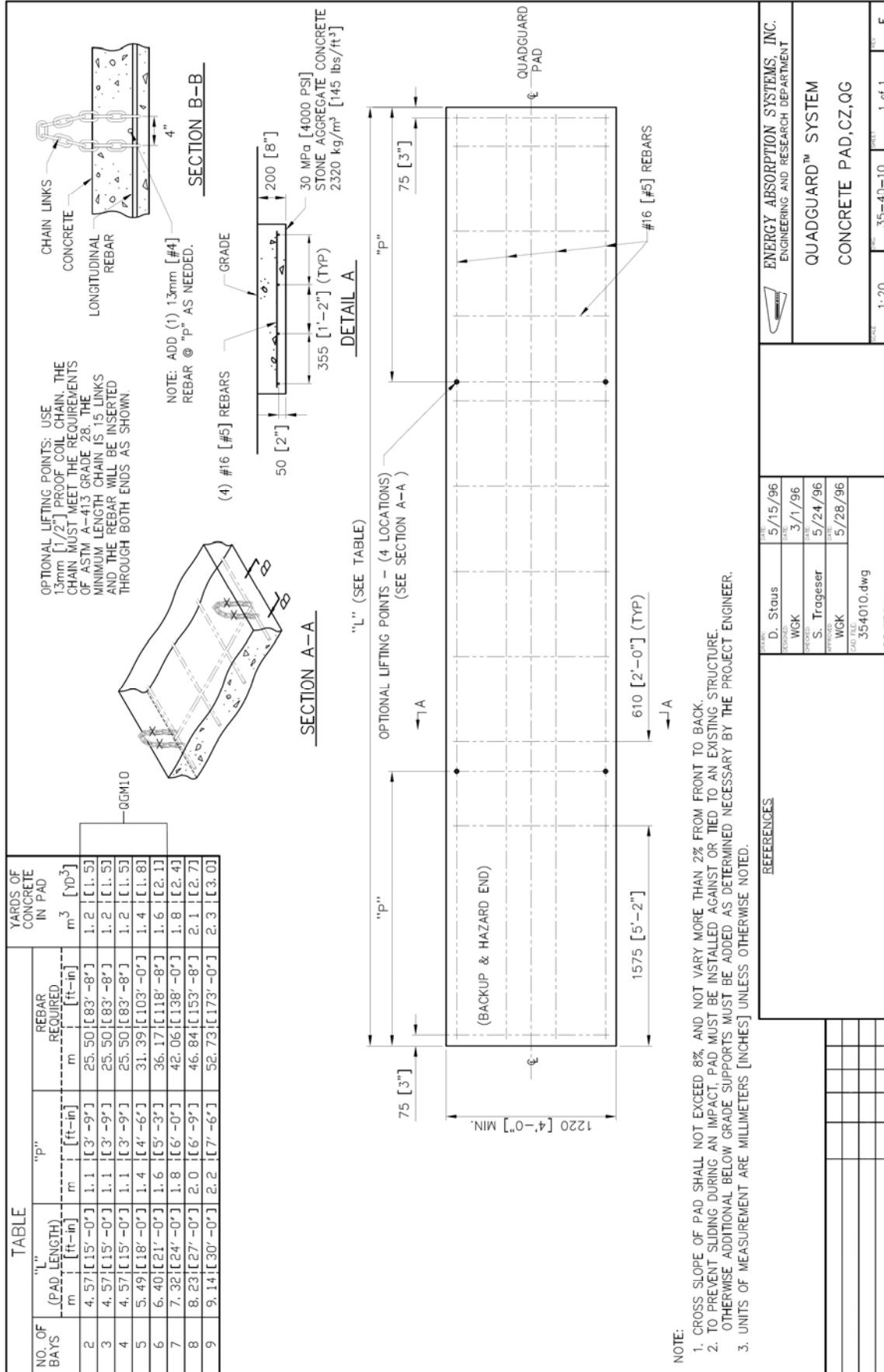
NOTES:

- USE ITEMS 1 AND 16 TO LOCATE HOLES IN CONCRETE.
- ITEMS 1 AND 16 TO BE CENTERED WITH CONCRETE BACKUP FACE
- ANCHOR KITTING BIT BAY BE REQUIRED TO ACHIEVE PROPER ANCHOR INSTALLATION.
- ANCHOR STUDS LOCATED IN UPPER VALLEY MUST EXTEND APPROXIMATELY 57 (2.25) FROM FACE OF CONCRETE TO FASTEN NUTS. WASHERS MAY BE OMITTED.

REFERENCES		QUADGUARD [®] SYSTEM	
SERIAL NO.	_____	BACKUP ASSY CONCRETE QG	_____
SALES ORDER	_____		_____
EH PROJECT	_____		_____
DESIGN SPEED	_____		_____
NOSE TYPE	_____		_____
NO. OF UNITS	_____		_____

REV. NO.	5/24/1996	REV. NO.	604507 Rev
DESIGNED BY	D. Sibus	DATE	6/5/1996
CHECKED BY	W. Krage	SCALE	DO NOT SCALE DRAWING
QUADGUARD [®] SYSTEM BACKUP ASSY CONCRETE QG ALL DIMENSIONS ARE IN INCHES (PARENTS IN METERS) DIMENSIONS ARE SHOWN TO 3 DECIMALS UNLESS OTHERWISE NOTED			

SERIAL NO. _____ SALES ORDER _____ EH PROJECT _____ DESIGN SPEED _____ NOSE TYPE _____ NO. OF UNITS _____	REFERENCE NO. 604507 SHEET NO. K OF 1
--	--

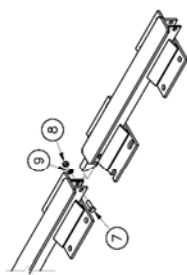


NOTE:

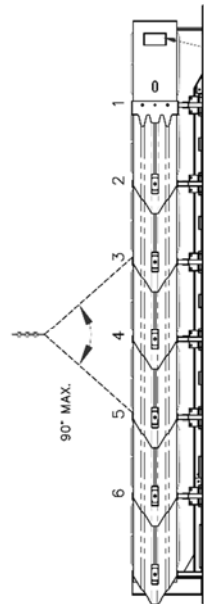
- CROSS SLOPE OF PAD SHALL NOT EXCEED 8%, AND NOT VARY MORE THAN 2% FROM FRONT TO BACK.
- TO PREVENT SLIDING DURING AN IMPACT, PAD MUST BE INSTALLED AGAINST OR TIED TO AN EXISTING STRUCTURE. OTHERWISE ADDITIONAL BELOW GRADE SUPPORTS MUST BE ADDED AS DETERMINED NECESSARY BY THE PROJECT ENGINEER.
- UNITS OF MEASUREMENT ARE MILLIMETERS [INCHES] UNLESS OTHERWISE NOTED.

Concrete Pad, CZ, QG

ITEM	STOCK NO.	DESCRIPTION	PARTS LIST								
			3	4	5	6	7	8	9		
1	116799	ROD,THREADED,3/4x18,Q5,G									
2	003704	NUT,HX,3/4,G,GR,DH									
3	118027	WASHER,FLAT,3/4X2,HVY,G									
4	118710	ADHESIVE,HY200,330,HL,TJ									
5	611207	LIFTING BRACKET,QG,CZ,G									
7	113660	BOLT,HX,5/8X3 1/2,Q5,G									
8	003354	NUT,HX,5/8,G									
9	118100	WASHER,LOCK,5/8,G									
10	115394	INST_QG_CZ ANCHOR/LIFT KIT									
11	115501	LABEL,CRATE,QG_CZ,LIFT KIT									
12	113797	HIT-RB 7/8" KIT									



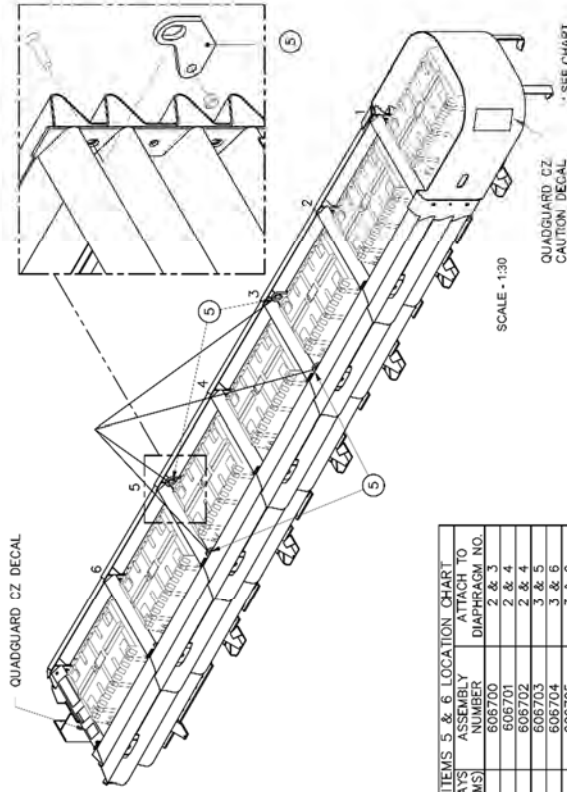
MONORAIL ATTACHMENT
SCALE - 1:25



EXAMPLE:
6 BAY QUADGUARD CZ
SCALE - 1:50

TO MOVE SYSTEM:

1. Verify monorail sections are bolted together.
2. Attach two lifting brackets each on diaphragms listed (four brackets total). See example.
3. Minimum sling length 3 meters (9 ft). Use fixed equal length slings.
4. Free unit from anchor bolts & grout prior to lifting the system. To accomplish this, start at the front of the unit and work back to the rear. Place blocks such as 2X4s under the monorail and work down the length of unit until the unit is completely free of the studs.
5. Lift the system to new location and re-anchor.
6. ANCHOR SYSTEM FOR PROPER IMPACT PERFORMANCE. Use The Adhesive anchor system, supplied by TRINITY HIGHWAY, or approved equal. QuadGuard cz Systems installed on asphalt must be inspected to ensure the anchors are still properly set following each impact. Re-anchor as necessary. See drawing 35-40-06.



NO. OF BAYS (DIAPHRAGMS)	ASSEMBLY NUMBER	ATTACH TO DIAPHRAGM NO.
3	606700	2 & 3
4	606701	2 & 4
5	606702	2 & 5
6	606703	3 & 6
7	606704	3 & 7
8	606705	4 & 8
9	606706	4 & 9

ASSEMBLY NO. 60670*



QuadGuard® SYSTEM
CZ ANCHOR / LIFTING KIT, QG,
(3-9 BAYS)

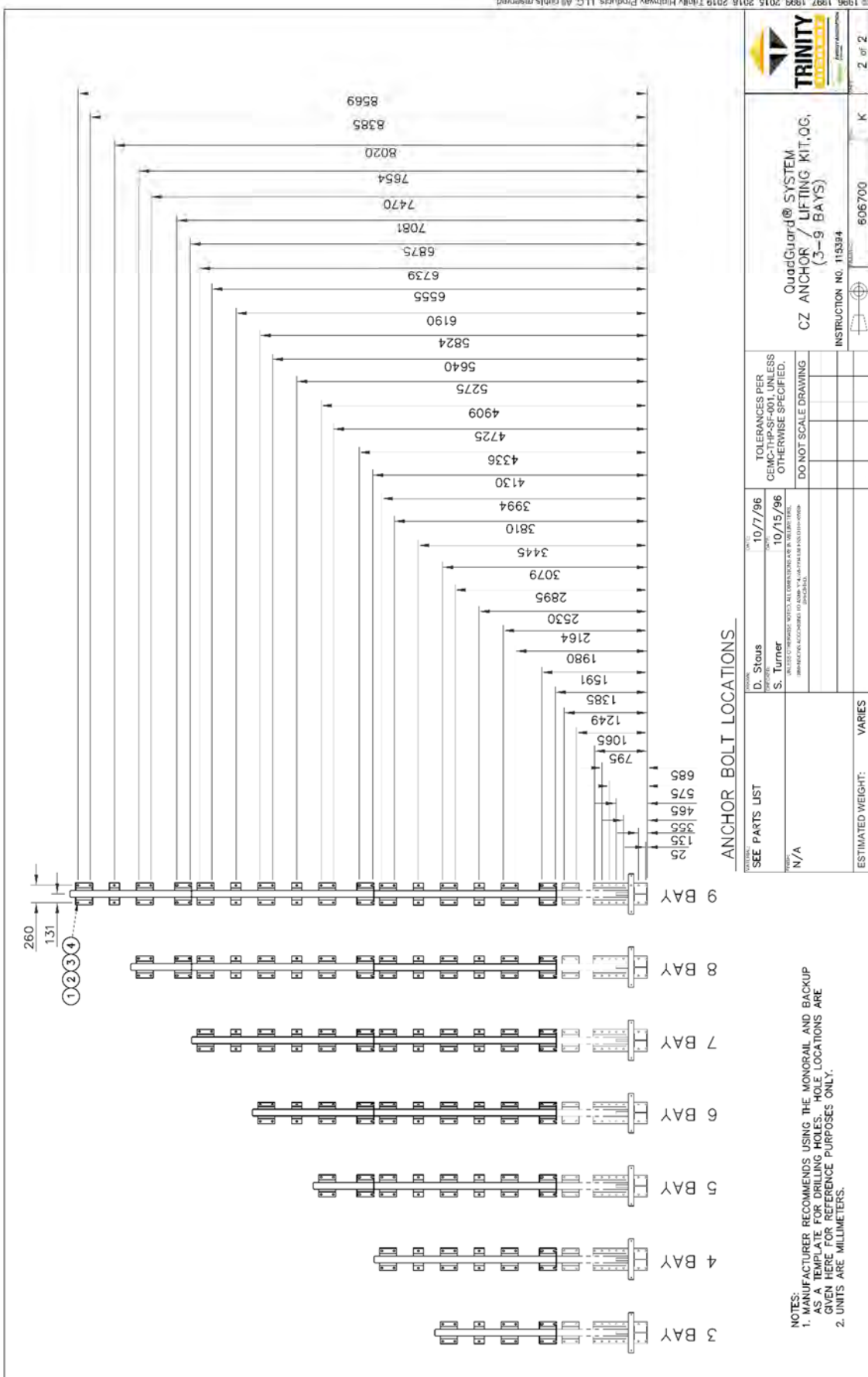
INSTRUCTION NO. 115394

DESIGNED BY	D. Staus	DATE	10/7/96
CHECKED BY	S. Turner	DATE	10/15/96
APPROVED BY		DATE	
EXPOSURE ACCORDING TO AASHTO T-111, 118, 119, 120, 121, 122, 123, 124, 125, 126, 127, 128, 129, 130, 131, 132, 133, 134, 135, 136, 137, 138, 139, 140, 141, 142, 143, 144, 145, 146, 147, 148, 149, 150, 151, 152, 153, 154, 155, 156, 157, 158, 159, 160, 161, 162, 163, 164, 165, 166, 167, 168, 169, 170, 171, 172, 173, 174, 175, 176, 177, 178, 179, 180, 181, 182, 183, 184, 185, 186, 187, 188, 189, 190, 191, 192, 193, 194, 195, 196, 197, 198, 199, 200, 201, 202, 203, 204, 205, 206, 207, 208, 209, 210, 211, 212, 213, 214, 215, 216, 217, 218, 219, 220, 221, 222, 223, 224, 225, 226, 227, 228, 229, 230, 231, 232, 233, 234, 235, 236, 237, 238, 239, 240, 241, 242, 243, 244, 245, 246, 247, 248, 249, 250, 251, 252, 253, 254, 255, 256, 257, 258, 259, 260, 261, 262, 263, 264, 265, 266, 267, 268, 269, 270, 271, 272, 273, 274, 275, 276, 277, 278, 279, 280, 281, 282, 283, 284, 285, 286, 287, 288, 289, 290, 291, 292, 293, 294, 295, 296, 297, 298, 299, 300, 301, 302, 303, 304, 305, 306, 307, 308, 309, 310, 311, 312, 313, 314, 315, 316, 317, 318, 319, 320, 321, 322, 323, 324, 325, 326, 327, 328, 329, 330, 331, 332, 333, 334, 335, 336, 337, 338, 339, 340, 341, 342, 343, 344, 345, 346, 347, 348, 349, 350, 351, 352, 353, 354, 355, 356, 357, 358, 359, 360, 361, 362, 363, 364, 365, 366, 367, 368, 369, 370, 371, 372, 373, 374, 375, 376, 377, 378, 379, 380, 381, 382, 383, 384, 385, 386, 387, 388, 389, 390, 391, 392, 393, 394, 395, 396, 397, 398, 399, 400, 401, 402, 403, 404, 405, 406, 407, 408, 409, 410, 411, 412, 413, 414, 415, 416, 417, 418, 419, 420, 421, 422, 423, 424, 425, 426, 427, 428, 429, 430, 431, 432, 433, 434, 435, 436, 437, 438, 439, 440, 441, 442, 443, 444, 445, 446, 447, 448, 449, 450, 451, 452, 453, 454, 455, 456, 457, 458, 459, 460, 461, 462, 463, 464, 465, 466, 467, 468, 469, 470, 471, 472, 473, 474, 475, 476, 477, 478, 479, 480, 481, 482, 483, 484, 485, 486, 487, 488, 489, 490, 491, 492, 493, 494, 495, 496, 497, 498, 499, 500, 501, 502, 503, 504, 505, 506, 507, 508, 509, 510, 511, 512, 513, 514, 515, 516, 517, 518, 519, 520, 521, 522, 523, 524, 525, 526, 527, 528, 529, 530, 531, 532, 533, 534, 535, 536, 537, 538, 539, 540, 541, 542, 543, 544, 545, 546, 547, 548, 549, 550, 551, 552, 553, 554, 555, 556, 557, 558, 559, 560, 561, 562, 563, 564, 565, 566, 567, 568, 569, 570, 571, 572, 573, 574, 575, 576, 577, 578, 579, 580, 581, 582, 583, 584, 585, 586, 587, 588, 589, 590, 591, 592, 593, 594, 595, 596, 597, 598, 599, 600, 601, 602, 603, 604, 605, 606, 607, 608, 609, 610, 611, 612, 613, 614, 615, 616, 617, 618, 619, 620, 621, 622, 623, 624, 625, 626, 627, 628, 629, 630, 631, 632, 633, 634, 635, 636, 637, 638, 639, 640, 641, 642, 643, 644, 645, 646, 647, 648, 649, 650, 651, 652, 653, 654, 655, 656, 657, 658, 659, 660, 661, 662, 663, 664, 665, 666, 667, 668, 669, 670, 671, 672, 673, 674, 675, 676, 677, 678, 679, 680, 681, 682, 683, 684, 685, 686, 687, 688, 689, 690, 691, 692, 693, 694, 695, 696, 697, 698, 699, 700, 701, 702, 703, 704, 705, 706, 707, 708, 709, 710, 711, 712, 713, 714, 715, 716, 717, 718, 719, 720, 721, 722, 723, 724, 725, 726, 727, 728, 729, 730, 731, 732, 733, 734, 735, 736, 737, 738, 739, 740, 741, 742, 743, 744, 745, 746, 747, 748, 749, 750, 751, 752, 753, 754, 755, 756, 757, 758, 759, 760, 761, 762, 763, 764, 765, 766, 767, 768, 769, 770, 771, 772, 773, 774, 775, 776, 777, 778, 779, 780, 781, 782, 783, 784, 785, 786, 787, 788, 789, 790, 791, 792, 793, 794, 795, 796, 797, 798, 799, 800, 801, 802, 803, 804, 805, 806, 807, 808, 809, 810, 811, 812, 813, 814, 815, 816, 817, 818, 819, 820, 821, 822, 823, 824, 825, 826, 827, 828, 829, 830, 831, 832, 833, 834, 835, 836, 837, 838, 839, 840, 841, 842, 843, 844, 845, 846, 847, 848, 849, 850, 851, 852, 853, 854, 855, 856, 857, 858, 859, 860, 861, 862, 863, 864, 865, 866, 867, 868, 869, 870, 871, 872, 873, 874, 875, 876, 877, 878, 879, 880, 881, 882, 883, 884, 885, 886, 887, 888, 889, 890, 891, 892, 893, 894, 895, 896, 897, 898, 899, 900, 901, 902, 903, 904, 905, 906, 907, 908, 909, 910, 911, 912, 913, 914, 915, 916, 917, 918, 919, 920, 921, 922, 923, 924, 925, 926, 927, 928, 929, 930, 931, 932, 933, 934, 935, 936, 937, 938, 939, 940, 941, 942, 943, 944, 945, 946, 947, 948, 949, 950, 951, 952, 953, 954, 955, 956, 957, 958, 959, 960, 961, 962, 963, 964, 965, 966, 967, 968, 969, 970, 971, 972, 973, 974, 975, 976, 977, 978, 979, 980, 981, 982, 983, 984, 985, 986, 987, 988, 989, 990, 991, 992, 993, 994, 995, 996, 997, 998, 999, 1000			

1 of 2

606700 K

CZ Anchor/Lifting Kit, QG, (3-9 Bays)



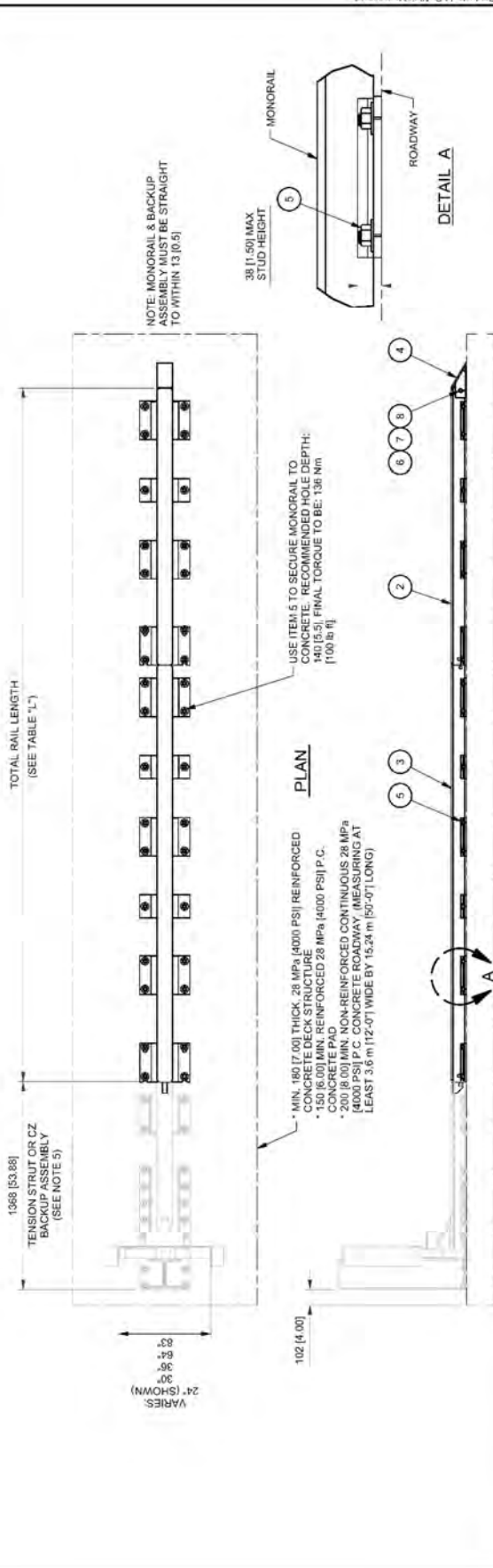
QuadGuard® SYSTEM
 CZ ANCHOR / LIFTING KIT, QG,
 (3-9 BAYS)

606700 K
 2 of 2

611367 - 1 of 3

ASSEMBLY NO.	TOTAL RAIL LENGTH	TABLE "L"				NO. OF BAYS	NOT APPLICABLE FOR 1/2 OR CZ CG SYSTEMS
		ITEM 1	ITEM 2	ITEM 3	ITEM 5		
611367	0	0	0	0	1		
611332	915 (96.5)	1	0	2	2		
611334	1830 (172.0)	0	1	0	4		
611340	2745 (108.1)	0	0	1	5		
611343	3660 (144.1)	1	0	1	7		
611349	4575 (180.1)	0	1	1	9		
611356	7320 (288.2)	0	1	2	14		

* SEE TABLE L



NOTES:

1. USE MONORAILS (ITEM 1, 2 AND 3) AS TEMPLATE(S) TO LOCATE ANCHOR BOLTS (ITEM 5). SEE SHEET 2.
2. CROSS SLOPE OF PAD SHALL NOT EXCEED 8%, AND NOT VARY MORE THAN 2% FROM FRONT TO BACK.
3. EVERY STUD MUST BE EMBEDDED TO A DEPTH OF 140 (5.5) IF REBAR IS ENCOUNTERED IN A P.C. CONCRETE PAD. IF REBAR IS NOT ENCOUNTERED ON A DECK STRUCTURE, ASK PROJECT ENGINEER FOR DIRECTION.
4. FOR CZ SYSTEMS, SEE DRAWING 35-40-24.

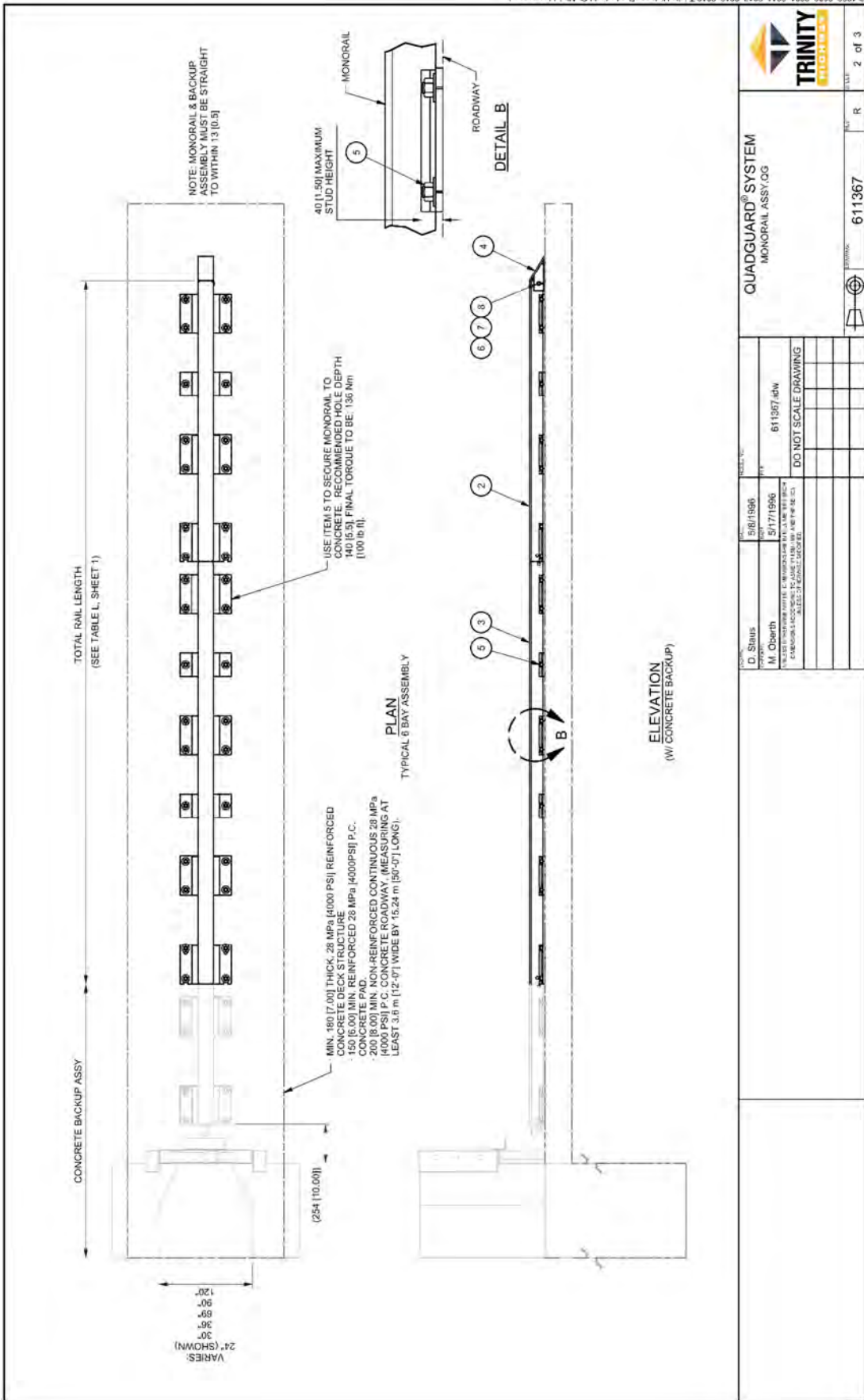
ITEM	STOCK NO.	DESCRIPTION	QTY.
1	611370	MONORAIL ONE BAY, W/ SLOTS, O.G.G.	*
2	611375	MONORAIL 2 BAYS, O.G.	*
3	611379	MONORAIL 3 BAYS, O.G.	*
4	608136	ENDCAP MONORAIL, O.G.	1
5	619316	ANCHOR KIT - HLT L 3/4 X 7 (4)	*
6	113660	BOLT, HK, 5/8 X 3 1/2, G5, G	1
7	118100	WASHER, LOCK, 5/8, G	1
8	002354	5/8" HXY HEX NUT A563A	1

QUADGUARD SYSTEM	
MONORAIL ASSY, O.G.	
DATE	5/8/1986
DESIGNED BY	M. Oberth
CHECKED BY	5/17/1986
PROJECT NO.	611387.dwg
DO NOT SCALE DRAWING	

ASSEMBLY NO.	611367	REV.	1	OF	3
TRINITY HIGHWAY					

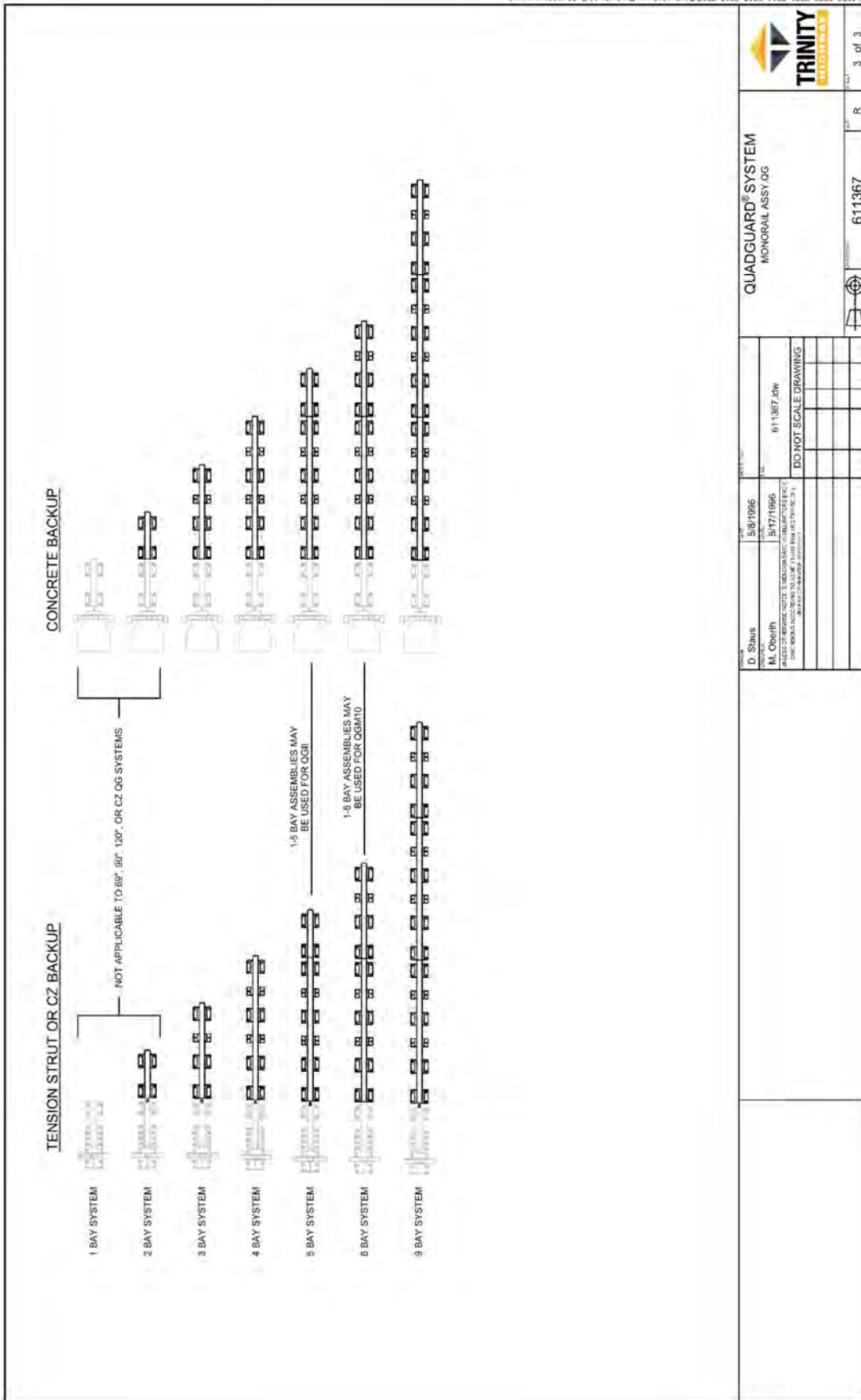
Monorail Assembly

611367 - 2 of 3



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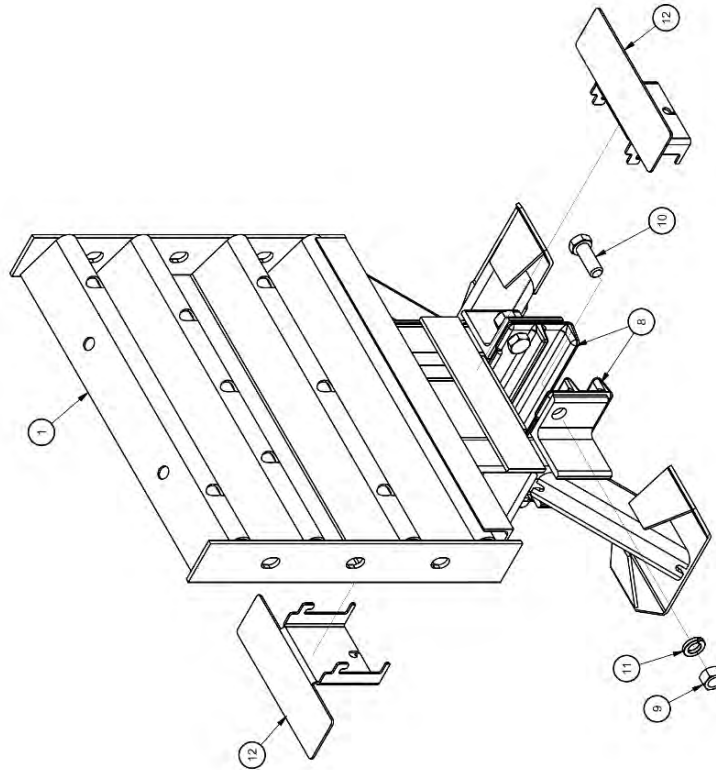
611367 – 3 of 3



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		QUADGUARD® SYSTEM MONORAIL ASSY.QG	
DESIGNER D. Shibus	DATE 5/8/1996	DESIGNED BY M. Oberth	DATE 5/17/1996
PROJECT QUADGUARD MONORAIL SYSTEMS TO OGI		DRAWING NO. 611367.dwg	
DO NOT SCALE DRAWING			
SCALE			
SHEET NO.			
TOTAL SHEETS			
PROJECT NO.			
DRAWING NO.			
TITLE			
611367			
R			
3 of 3			

625650



PARTS LIST			
ITEM	STOCK NO.	DESCRIPTION	QTY.
1	SEE TABLE	SEE TABLE	1
8	811368	MONORAIL GUIDE QG.G	2
9	003704	3/4" HVY HEX NUT A-683 DH	4
10	119555	BOLT HK-3/4X2.38.G	4
11	118089	WASHER LOCK-3/4.G	4
12	805446	BRACKET CARTRIDGE SUPT DIA.FOLDED QG.G	2

ASSY. NO.	ITEM I.	DESCRIPTION	WIDTH
625650	625647	DIAPHRAGM.QB.24.QG.G	810 [24.00]
625651	625648	DIAPHRAGM.QB.30.QG.G	760 [30.00]
625652	625649	DIAPHRAGM.QB.36.QG.G	815 [36.00]
606810	607838	DIAPHRAGM.QB.48.QG.G	1219 [48.00]

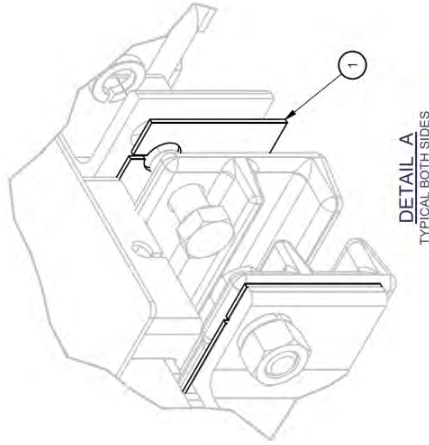
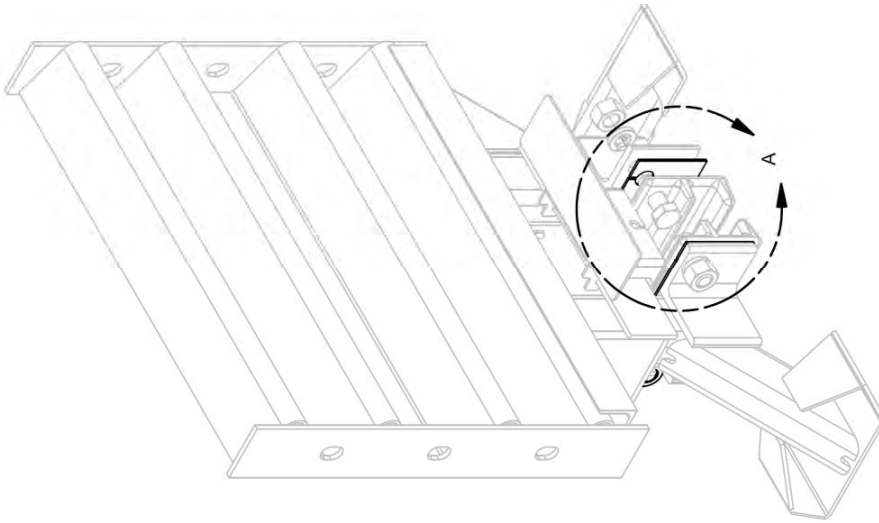
NOTE:
1. QUADGUARD II REQUIRES THE SHIM KIT, SEE 614050.

		DIAPHRAGM ASSY., QB, 24"	
W. Leddington A. Van Brocklin		SEE TABLE 625650.idw	
DATE: 4/13/2016 DATE: 4/28/2016		DO NOT SCALE DRAWING	
REVISION ECO Dwg Rev By Chk 4016 4/13/16 / WWIL AVB		INITIAL RELEASE 4781 5/31/17 A WWIL ARV	
UPDATED NOTE 2: HANDED LEANER TEXT SHEET TYPES: 625650: DELIVERED PORTFOLIO BLENDED SHEETS 2 & 3 FOR 30" & 48" DIAPHRAGMS		PART: 625650 1 of 3	

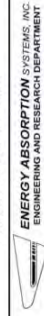
Diaphragm Assembly, QB

614050

PARTS LIST			
ITEM	STOCK NO.	DESCRIPTION	QTY.
1	614052G	SHIM,1/8X3 5.8X8.G	2



ASSEMBLY NO. 614050B



SHIM KIT, DIAPHRAGM, RAIL GUIDE, QG II

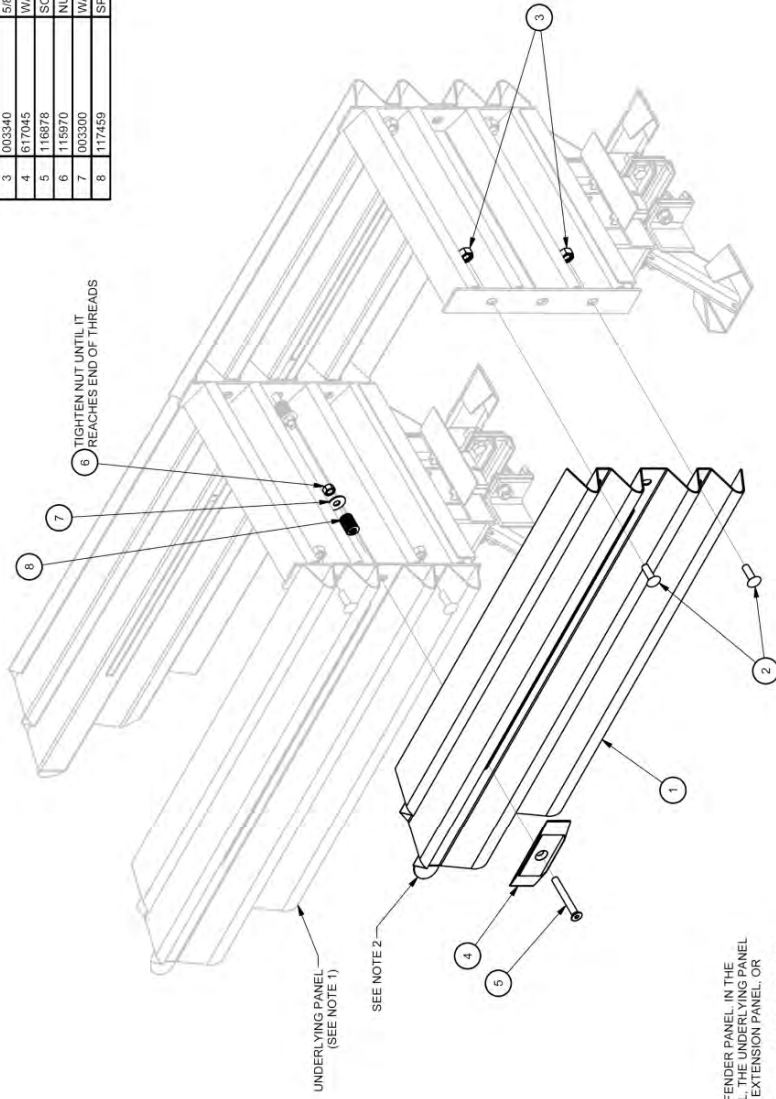
DESIGNED BY	D. Kohfeld	DATE	2/27/2009
REVIEWED BY	M. Buehler	DATE	12/02/2008
DESIGNED BY	JME	DATE	3/4/2008
APPROVED BY	MJB	DATE	3/19/2009
FILE	614050.idw		
DWG FILE ASSEMBLY			

SCALE	DRAWING	614050	SHEET	1	of	1	REV	C
-------	---------	--------	-------	---	----	---	-----	---

Shim Kit, Diaphragm, Rail Guide, QG II

608236

PARTS LIST			
ITEM	STOCK NO.	DESCRIPTION	QTY
1	611832	PANEL FENDER, QG	1
2	003400	BOLT, TRAIL, 5/8X2, G	2
3	003340	5/8" GR HEX NUT	2
4	617045	WASHER, MUSHROOM, FORGED, QG, G	1
5	116878	SCREW, FL, 5/8X5, GR, G, HEX SOCKET	1
6	116970	NUT, HX, 5/8, G	1
7	003300	WASHER, FLAT, 5/8 X 1.34, G	1
8	117459	SPRING, DIE, 1/4 ODD, 9/16X1 1/2, G	1



NOTES:
 1. UNDERLYING PANEL IS ANOTHER FENDER PANEL. IN THE CASE OF THE LAST FENDER PANEL, THE UNDERLYING PANEL MUST BE A BACKUP SIDE PANEL, EXTENSION PANEL, OR TRAIL END PANEL.
 2. THERE IS TO BE A 20 [78"] MAX. GAP BETWEEN ANY FENDER PANEL AND THE UNDERLYING PANEL.

		QUADGUARD® FENDER PANEL, ASSY, QG	
DRAWN: J. Espinoza DATE: 5/21/1996	CHECKED: J. Machado DATE: 5/21/1996	PART NO: 608236 FILE: 608236.idw	SHEET: 1 of 1
DO NOT SCALE DRAWING		PART: 608236	KIT: K

Fender Panel Assembly, QG

PARTS LIST			
ITEM	STOCK NO.	DESCRIPTION	QTY.
1	611689*	NOSE L NARROW QG II W/LOGO *	1
2	611680*	NOSE R NARROW QG II W/LOGO *	1
3	605430*	BRACKET CART SUPPORT NOSE QG II *	1
4	605420	BRACKET CART SUPPORT NOSE BAY QG II	1
5	113518	BOLT HK 1/4X3/4 G5.G	6
6	113404	BOLT BT 5/8X1 1/4 HK SOC.M GALV	6
7	118570	BOLT HK 5/8X2 G5.G	4
8	115846	NUT HK 1/4.G	6
9	000340	NUT HK 5/8.G RAIL	6
10	115966	NUT HEX COUPLING 5/8-11X2 1/8.G	6
11	118095	WASHER LOCK 1/4.G	6
12	000300	WASHER FLAT 5/8 X 1 3/4.G	12
13	806535	BRACKET PULL-OUT QG	2
14	118232	BOLT HK 5/8X2 1/2 G5.G	2

TABLE	
ASSEMBLY NO.	FINISH
611580	GALVANIZED
611581	YELLOW
611579	BLACK
621867	GALV/YELLOW

REV	DATE	BY	APP
D	2/26/2009	D	
MJB	3/19/2009		
DO NOT SCALE DRAWING			

TRINITY	611580
NOSE ASSY, QG II, NARROW	
611580	

Nose Assembly, QG II, Narrow

PARTS LIST			
ITEM	STOCK NO.	DESCRIPTION	QTY.
1	611680*	NOSE L,NARROW,QGII,W/LOGO,*	1
2	611680*	NOSE R,NARROW,QGII,W/LOGO,*	1
3	614487*	SPACER 12,NOSE ASSY,QGII,*	1
4	605420	BRACKET,CART SUPPORT,NOSE BAY,QGII	1
5	113518	BOLT,HX,1/4X3/4,GS,G	12
6	113404	BOLT,BT,5/8X1 1/4,HX,SOC,M,GALV	6
7	118570	BOLT,HX,5/8X2,GS,G	4
8	115946	NUT,HX,1/4,G	12
9	003340	NUT,HX,5/8,G,RAIL	6
10	115986	NUT,HEX,COUPLING,5/8-11X2 1/8,G	6
11	118065	WASHER,LOCK,1/4,G	12
12	003300	WASHER,FLAT,5/8 X 1 3/4, G	12
13	605535	BRACKET,PULL-OUT,OG,G	2
14	118232	BOLT,HX,5/8X2 1/2,GS,G	2

TABLE	
ASSEMBLY NO.	FINISH
611577	GALVANIZED
611578	YELLOW
611576	BLACK
62225	GALV/YELLOW

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		NOSE ASSY,QGII,48	
D. Kofield MJB <small>TRINITY HIGHWAY PRODUCTS, LLC 4810 W. BRANSHAW ROAD, SUITE 100 ELKHORN, NE 68022-2712, USA TEL: 402.486.1100 FAX: 402.486.1101</small>		611580.dwg DO NOT SCALE DRAWING	
DATE	2/26/2009	REV	J
ISSUE	3/19/2009	REV	
611580		2 of 2	

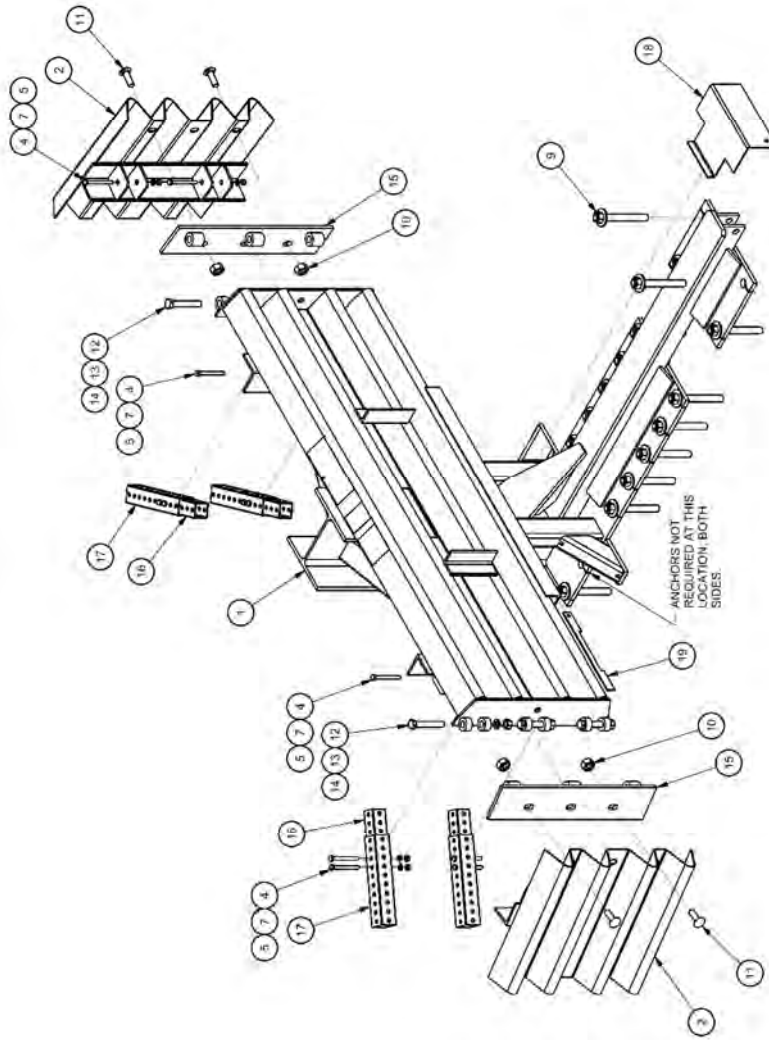
Nose Assembly, QG II, 48

604596

PARTS LIST			
ITEM	STOCK NO	DESCRIPTION	QTY.
1	SEE TABLE	BACKUP, TS, XX WIDE, WIDECAL	1
2	611900	PANEL, SIDE, QG, WIDE	2
4	113612	BOLT, HK, 3/8X3 1/2 ALL THREAD, G5, G	16
5	115960	NUT, HK, 3/8, G	16
7	118092	WASHER, LOCK, 3/8, G	16
9	619116	ANCHOR KIT, HILT, 3/4X7, (4)	5
10	1003440	NUT, HK, 5/8, G, RAIL	4
11	1003400	BOLT, TRAIL, 5/8X22, G	4
12	113668	BOLT, HK, 5/8X4, G5, G	6
13	118100	WASHER, LOCK, 5/8, G	6
14	1003354	5/8" HVT HEX NUT A563A	6
15	610172	HINGE PLATE, FENDER PANEL, QG	2
16	615156	TEL ST 1, 3/4X1, 3/4X1/2 GA X10, HHS, G	4
17	615165	TEL ST 2, 2X2X1/2 GA X10, HHS, G	4
18	605447	BRACKET, CARTRIDGE SUPT, TS, B/U, QG	1
19	611266	LOCKING BAR, CARTRIDGE SUPT, QG	1

TABLE		
ASSY NO.	DESCRIPTION	WIDTH
604596	BACKUP, TS, 64 WIDE, WIDECALS	1620 [64']
604599	BACKUP, TS, 83 QG, WIDE, WIDECALS	2100 [83']

NOTES:
 1. WHEN TRANSITIONING QUADGUARD SYSTEM TO EXISTING BARRIER, REFER TO THE TRANSITION ASSEMBLY DRAWINGS FOR PROPER USE OF SIDE PANEL, NO. 611888.



		QUADGUARD® SYSTEM BACKUP ASSY, TS, QG WIDE	
DATE: 7/11/1987 DRAWN BY: D. Stabis CHECKED BY: B. Kingle <small>UNLESS OTHERWISE SPECIFIED, ALL DIMENSIONS ARE IN INCHES. UNLESS OTHERWISE SPECIFIED, ALL DIMENSIONS ARE TO FACE UNLESS NOTED OTHERWISE. DIMENSIONS IN PARENTHESES ARE HIDDEN DIMENSIONS.</small>	NO. 604596 idw DO NOT SCALE DRAWING	PROJECT NO. 604596 SHEET NO. F	1 of 1 <small>ISSUE/REVISIONS</small>

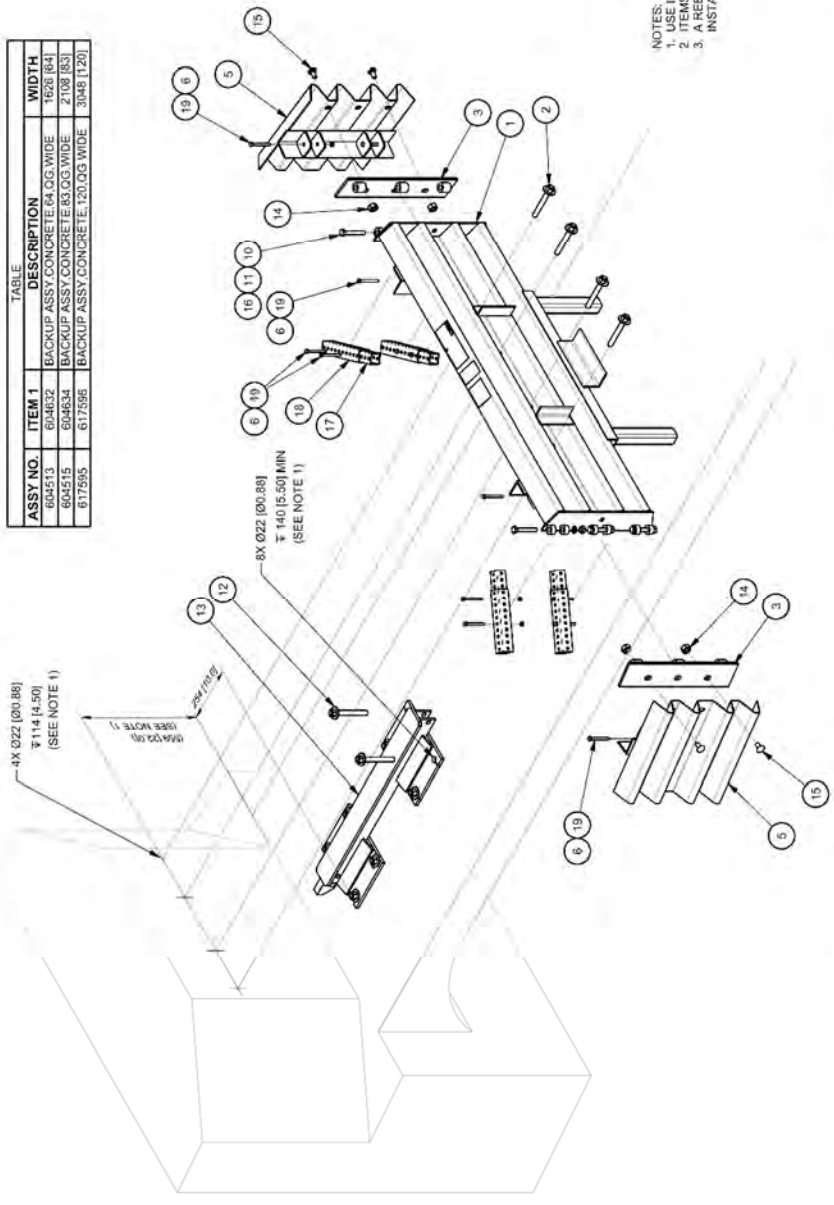
Backup Assembly, TS, QG Wide

604513

ASSY NO.	ITEM 1	DESCRIPTION	WIDTH
604513	604513	BACKUP ASSY CONCRETE 64.0G WIDE	1626 (84)
604515	604515	BACKUP ASSY CONCRETE 63.0G WIDE	2108 (83)
617595	617595	BACKUP ASSY CONCRETE 120.0G WIDE	3048 (120)

4x Ø22 (Ø0.88)
 ±114 (±5.0)
 (SEE NOTE 1)

8x Ø22 (Ø0.88)
 ±140 (±5.50) MIN
 (SEE NOTE 1)

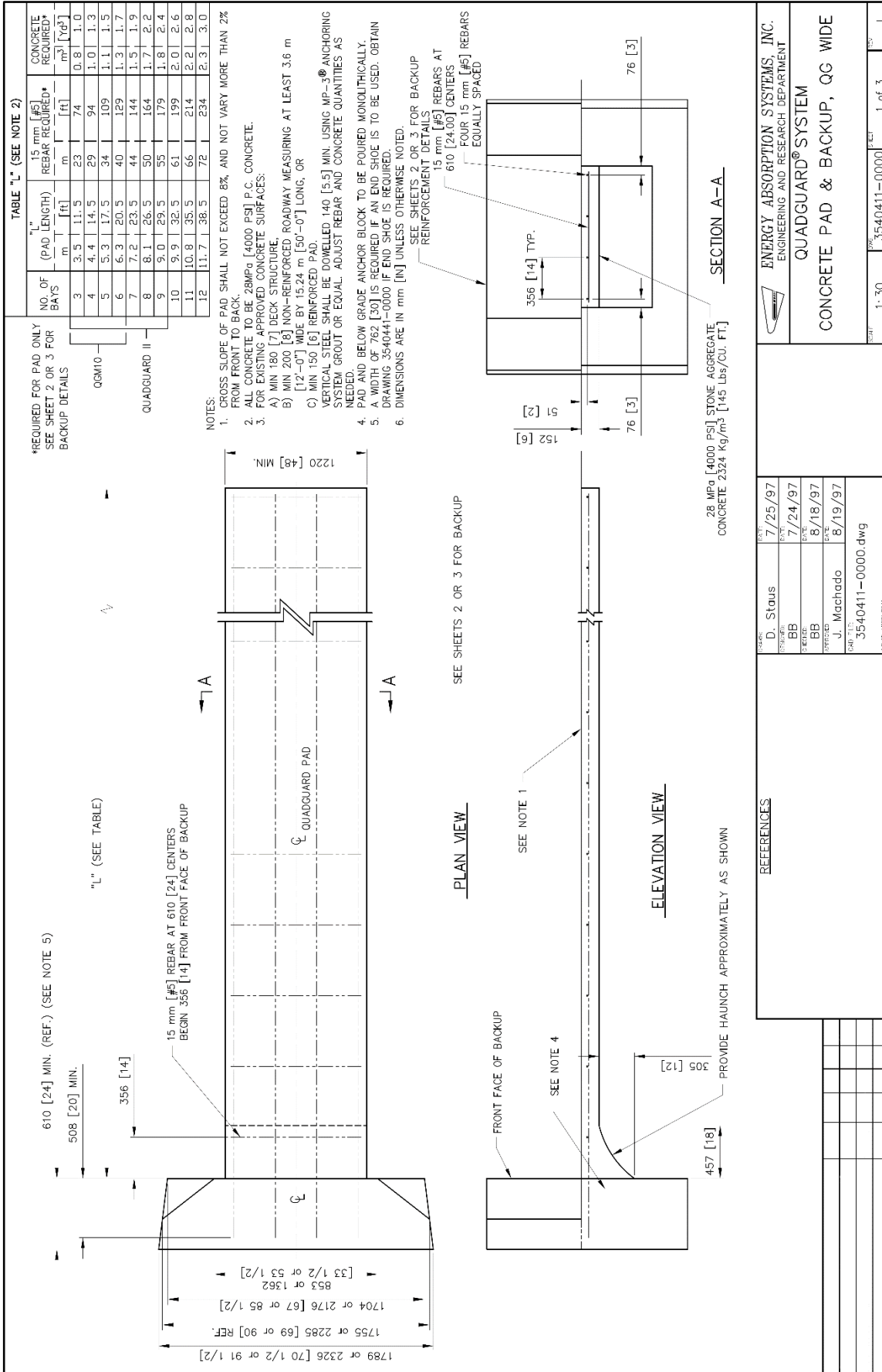


NOTES:
 1. USE ITEMS 1 AND 13 TO LOCATE HOLES IN CONCRETE.
 2. ITEMS 1 AND 13 TO BE CENTERED WITH CONCRETE BACKUP FACE.
 3. A REBAR CUTTING BIT MAY BE REQUIRED TO ACHIEVE PROPER ANCHOR INSTALLATION.

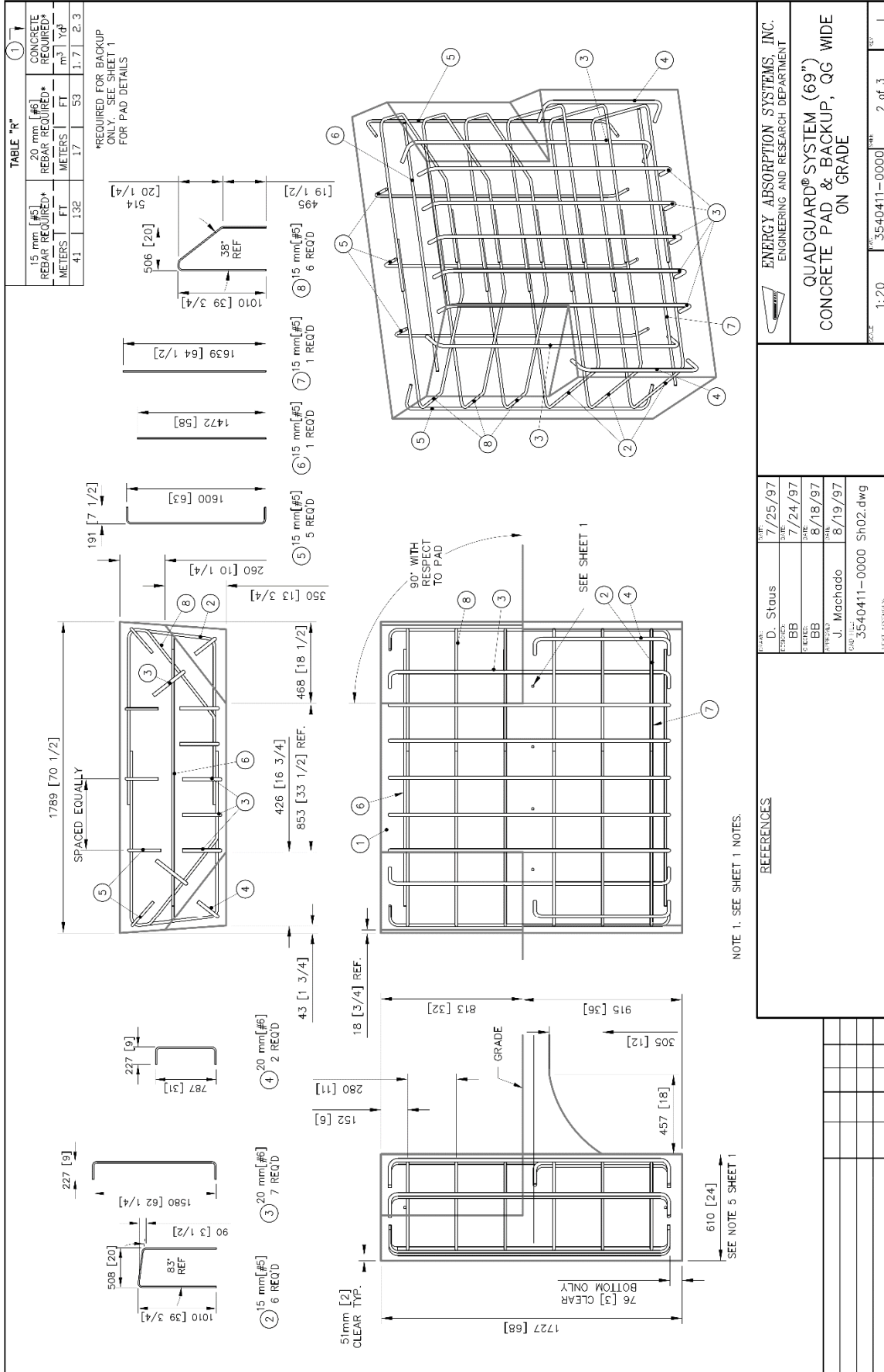
PARTS LIST			
ITEM	STOCK NO.	DESCRIPTION	QTY.
1	SEE TABLE	BACKUP FACE CONC.ØG WIDE G	1
2	618315	ANCH MIT.HIL.3/4X6 1/2(4)	1
3	610772	HINGE PLATE FENDER PANEL.ØG	2
5	611900	PANEL SIDE ØG.WIDE	2
6	115960	NUT.HX.3/8.G	16
10	115966	BOLT.HX.5/8X4.G5.G	6
11	118100	WASHER.LOCK.5/8.G	6
12	618216	ANCHOR KIT.HIL.3/4X7.(4)	2
13	611970	MONORAIL.1 BAY.ØG	1
14	003340	NUT.HX.5/8.G.RAIL	4
15	003360	5/8"X1.25" GR BOLT	4
16	003354	5/8" HVY HEX NUT A463A	6
17	615756	TEL ST 1.3/4X1.3/4X12 GA X10.HAS.G	4
18	615756	TEL ST 2KX12 GA X10.HAS.G	4
19	113512	BOLT.HX.3/8X3.1/2.ALL THREAD Ø5.G	16

		BACKUP ASSY, CONCRETE, XX, ØG, WIDE	
SERIAL NO. SALES ORDER EH PROJECT DESIGN SPEED NOSE TYPE NO OF UNITS	REFERENCES CONCRETE BACKUP, ØG WIDE 35-40-41	DATE 7/6/1987	DRAWING NO. 604513.kw
DO NOT SCALE DRAWING			
604513			
1 of 1			

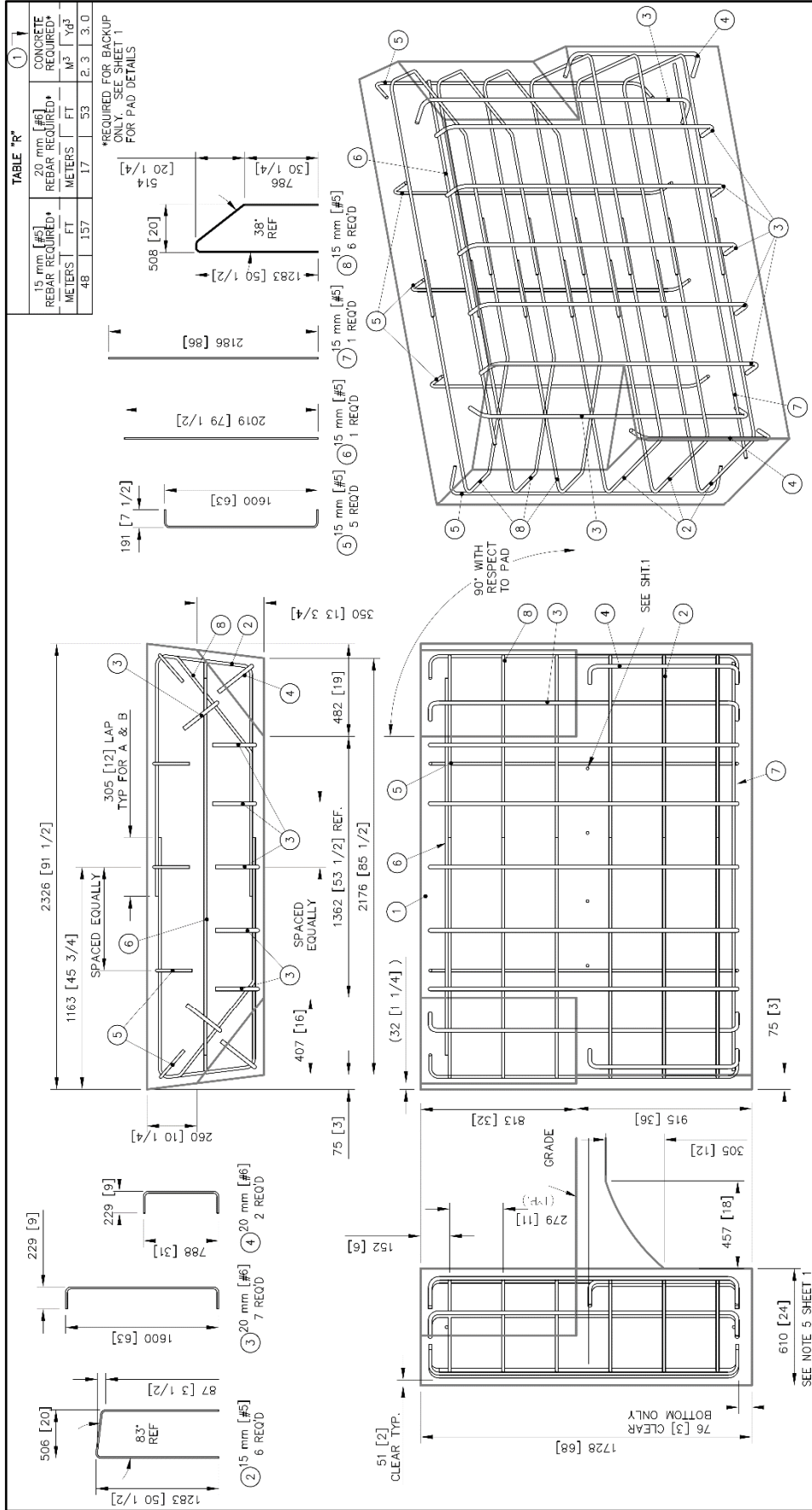
Backup Assembly, Concrete, QG Wide



Concrete Pad & Backup, QG Wide



(69") Concrete Pad & Backup, QG Wide on Grade



15 mm (#5)		20 mm (#6)		CONCRETE REQUIRED*	
METERS	FT	METERS	FT	M ³	Yd ³
48	157	17	53	2.3	3.0

*REQUIRED FOR BACKUP ONLY. SEE SHEET 1 FOR PAD DETAILS

ENERGY ABSORPTION SYSTEMS, INC. ENGINEERING AND RESEARCH DEPARTMENT		DATE: 7/25/97	BY: D. Staus
QUADGUARD® SYSTEM (90") CONCRETE PAD & BACKUP, QG WIDE ON GRADE		DATE: 7/24/97	BY: BB
		DATE: 8/18/97	BY: BB
		DATE: 8/19/97	BY: J. Machado
SCALE: 1:20		PROJECT: 3540411-0000	SHEET: SH03.dwg
TOTAL: 1:20		NO. OF SHEETS: 3540411-0000	SHEET NO.: 3 of 3

(90") Concrete Pad & Backup, QG Wide on Grade

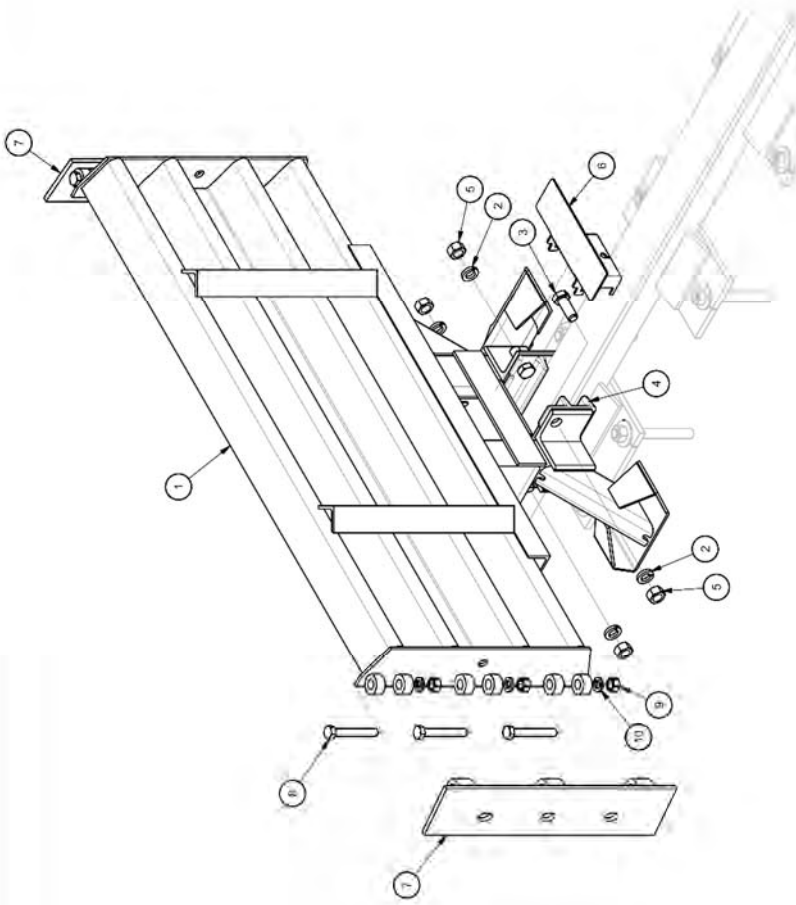
607173 - 1 of 2

PARTS LIST			
ITEM	STOCK NO.	DESCRIPTION	QTY.
11	SEE TABLE	DIAPHRAGM LOG G	1
2	118089	WASHER LOCK 3/4.G	4
3	113555	BOLT HK 3/4X2.08.G	4
4	611368	MONORAIL GUIDE CG G	2
5	003704	3/4" HXV HEX NUT A563 DH	4
6	605446	BRACKET CARTRIDGE SUPT DIA FOLDED QG	2
7	610172	HINGE PLATE FENDER PANEL QG	2
8	113666	BOLT HK 5/8X4.GS.G	6
9	003354	5/8" HXV HEX NUT A563A	6
10	118100	WASHER LOCK 5/8.G	6

Table		
ASSEMBLY NO.	DESCRIPTION	ITEM 1 PART NO.
*607173	DIAPHRAGM ASSY QG 0673	607766
*607174	DIAPHRAGM ASSY QG 0753	607700
*607175	DIAPHRAGM ASSY QG 0833	607771
*607176	DIAPHRAGM ASSY QG 0913	607773
*607177	DIAPHRAGM ASSY QG 0993	607775
*607145	DIAPHRAGM ASSY QG 1073	607777
607146	DIAPHRAGM ASSY QG 1153	607780
607148	DIAPHRAGM ASSY QG 1233	607783
607149	DIAPHRAGM ASSY QG 1273	607787
607150	DIAPHRAGM ASSY QG 1313	607788
607151	DIAPHRAGM ASSY QG 1393	607792
607152	DIAPHRAGM ASSY QG 1473	607796
607156	DIAPHRAGM ASSY QG 1513	607800
607157	DIAPHRAGM ASSY QG 1553	607801
607158	DIAPHRAGM ASSY QG 1633	607804
607160	DIAPHRAGM ASSY QG 1729	607806
607162	DIAPHRAGM ASSY QG 1793	607808
607163	DIAPHRAGM ASSY QG 1873	607811
*607164	DIAPHRAGM ASSY QG 1953	607813
*607164	DIAPHRAGM ASSY QG 2033	607815

* NO LONGER AVAILABLE

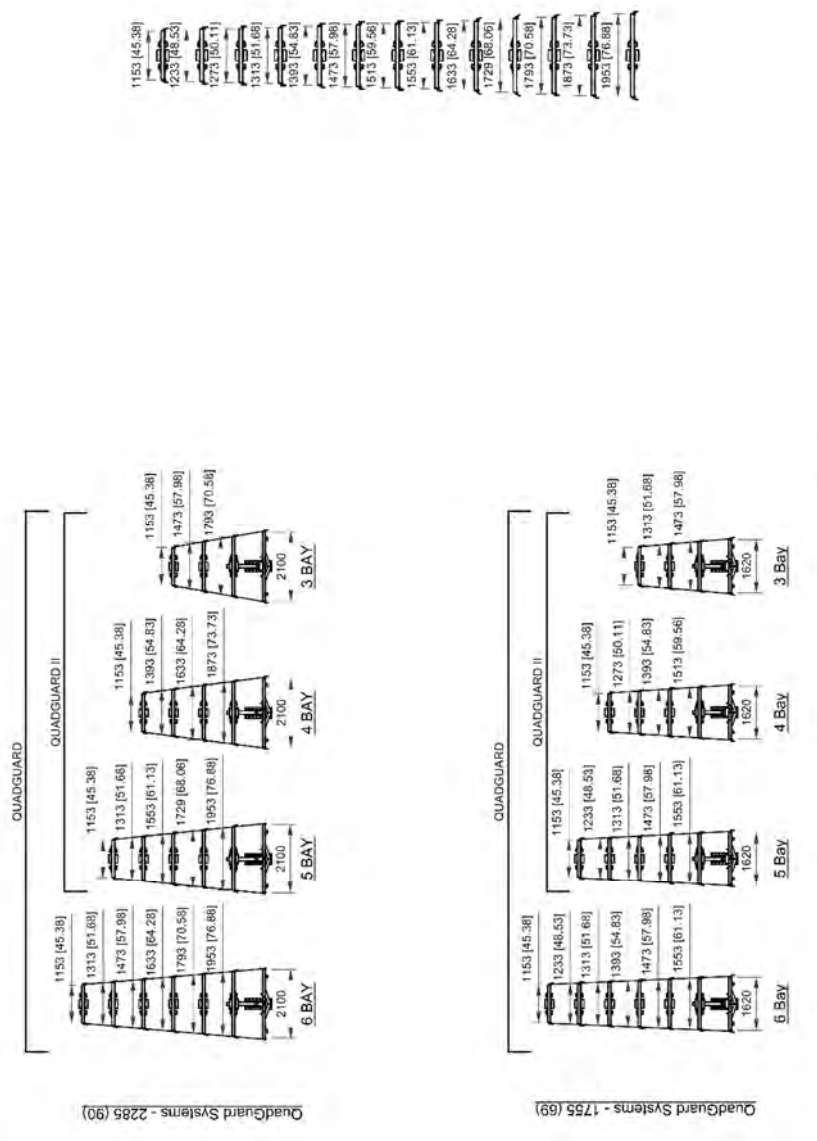
NOTE:
1. QJAGUARD IF LAND QGM10 REQUIRE SHIM KIT.
SEE DRAWING 614050.



		1 of 2	
D. Shaub J. Murchio 5/12/1997 7/7/1997 DO NOT SCALE DRAWING		607173.dwg DO NOT SCALE DRAWING	
DIAPHRAGM ASSY, QG, WIDE		607173	

Diaphragm Assembly, QG, Wide

607173 - 2 of 2



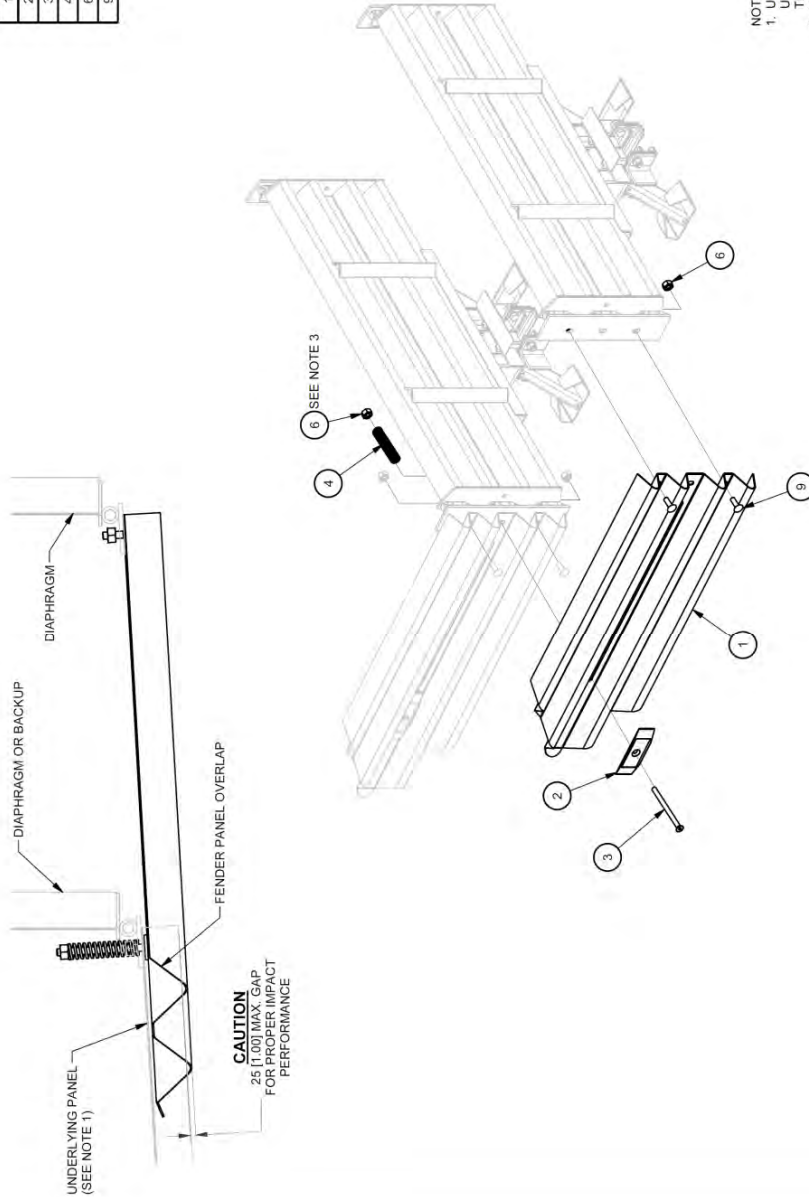
NOTE:
1. DIMENSIONS ARE IN (mm) [IN] UNLESS OTHERWISE NOTED.

		DIAPHRAGM ASSY., QG, WIDE		607173		N		2 of 2	
D. Staus 5/12/1987	J. Machado 7/7/1997	607173-0W		DO NOT SCALE DRAWING					
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608241

PARTS LIST			
ITEM	STOCK NO.	DESCRIPTION	QTY.
1	611832	PANEL,FENDER,OG	1
2	617045	WASHER,MUSHROOM,FORGED,OG,G	1
3	116879	SCREW,FL,5/8X8 1/2,G8,G,SOCKET	1
4	117458	SPRING,DIE,1 1/2 OD X3/4X6,GALV	1
6	003340	NUT,HX,5/8,G,RAIL	3
9	003400	BOLT,RAIL,5/8X2,G	2

TWO FENDER PANEL ASSEMBLIES REQUIRED PER BAY.



- NOTES:
1. UNDERLYING PANEL IS A FENDER PANEL IF ATTACHED TO A DIAPHRAGM. UNDERLYING PANEL IS A BACKUP SIDE PANEL, EXTENSION PANEL OR TRANSITION PANEL IF ATTACHED TO THE BACKUP.
 2. UNITS OF MEASUREMENT ARE MILLIMETERS (INCHES) UNLESS OTHERWISE NOTED.
 3. TIGHTEN NUT UNTIL IT REACHES END OF THREADS.

ASSEMBLY NO. 608241

DESIGNED BY	D. Staus	DATE	6/12/1987
DRAWN BY	J. Machado	DATE	4/10/1987
CHECKED BY	KRM	DATE	7/7/1997
APPROVED BY	J. Machado	DATE	7/7/1997
FILE	608241.dwg		

QuadGuard - Wide System
FENDER PANEL ASSEMBLY

SCALE	1 : 16	DRAWING NO.	608241	SHEET	1	OF	1	REV.	J
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Wide System Fender Panel Assembly

611583

PARTS LIST			
ITEM	STOCK NO	DESCRIPTION	QTY
1	611672*	NOSE L.WIDE QGII.W/LOGO*	1
2	611683*	NOSE R.WIDE QGII.W/LOGO*	1
3	605430*	BRACKET CART SUPPORT NOSE QGII.*	1
4	605420	BRACKET CART SUPPORT NOSE BAY QGII	1
5	113518	BOLT.HX.1/4X3/4.G5.G	6
6	113404	BOLT.BT.5/8X1 1/4.HX.SOC.M GALV	6
7	118570	BOLT.HX.5/8X2.65.G	6
8	115946	NUT.HX.1/4.G	6
9	103340	NUT.HX.5/8.G.RAIL	8
10	115986	NUT.HEX.COUPLING.5/8-11X2.1/8.G	6
11	118085	WASHER.LOCK.1/4.G	6
12	003300	WASHER.FLAT.5/8 X 1 3/4. G	12
13	113664	BOLT.HX.5/8X1 1/2.G5.G	2
14	605535	BRACKET/PULL-OUT.OG	2

TABLE	
ASSEMBLY NO.	FINISH
611583	GALVANIZED
611584	YELLOW
611582	BLACK
621868	GALV/YELLOW

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TRINITY HIGHWAY

NOSE ASSY QGII, WIDE

611583

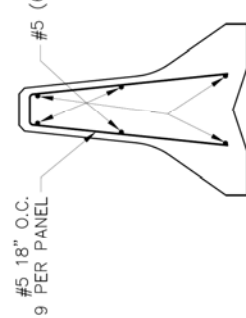
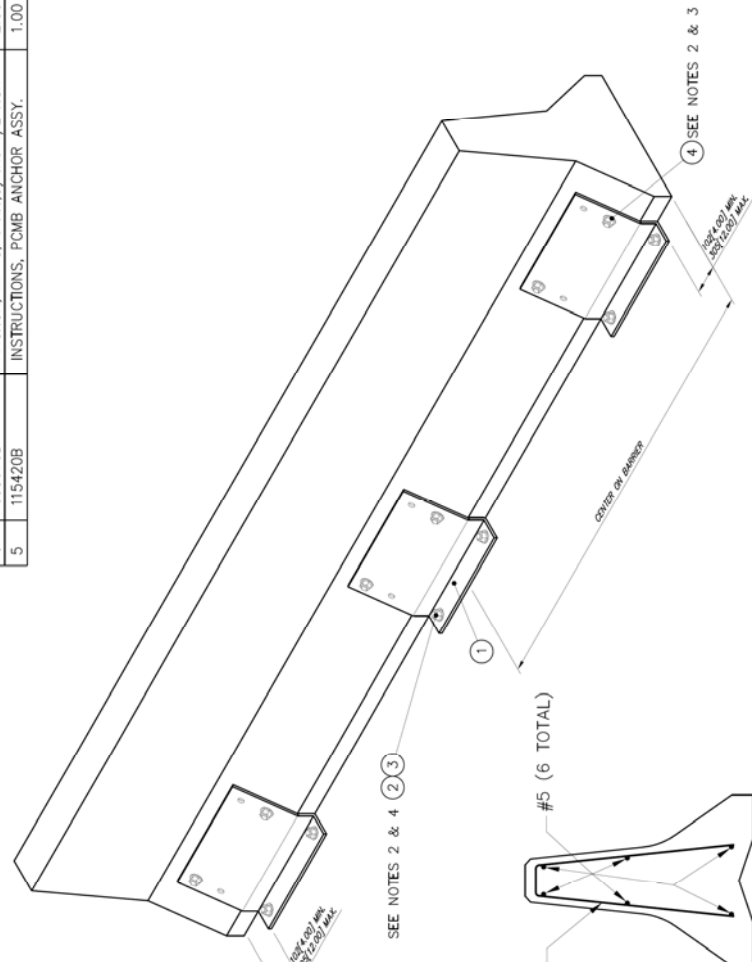
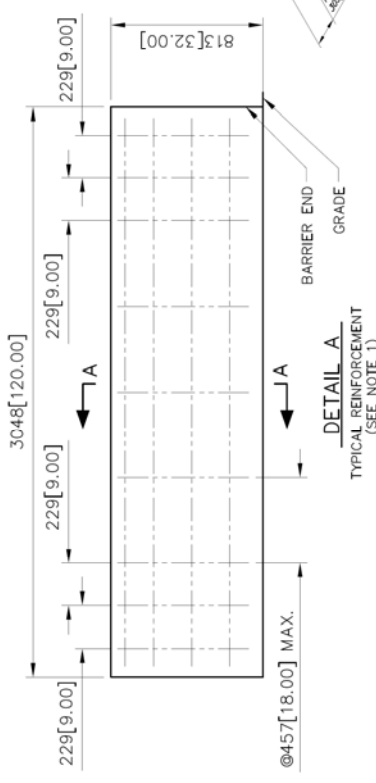
1 of 1

<table border="1"> <tr> <td>Author</td> <td>D. Kohlsted</td> <td>Date</td> <td>4/3/2009</td> </tr> <tr> <td>Drawn</td> <td>H. Broughtner</td> <td>Date</td> <td>3/6/2009</td> </tr> <tr> <td colspan="4"> DO NOT SCALE DRAWING </td> </tr> </table>	Author	D. Kohlsted	Date	4/3/2009	Drawn	H. Broughtner	Date	3/6/2009	DO NOT SCALE DRAWING				<table border="1"> <tr> <td>Part No.</td> <td>611583</td> </tr> <tr> <td>Rev.</td> <td>1.0</td> </tr> </table>	Part No.	611583	Rev.	1.0
Author	D. Kohlsted	Date	4/3/2009														
Drawn	H. Broughtner	Date	3/6/2009														
DO NOT SCALE DRAWING																	
Part No.	611583																
Rev.	1.0																

Nose Assembly, QG II, Wide

612006

ASSEMBLY NO.		ITEM 1		ITEM 1 DESCRIPTION		ITEM		STOCK NO.		DESCRIPTION		REQ'D
612006B		612006G		ANCHOR,PCMB,OG,G		1		SEE TABLE		SEE TABLE		6.00
603648B		603653G		ANCHOR,BARRIER,F-SHAPE,G		2		603676B		ANCHOR,MP-3,QUART KIT,CZ		3.00
						3		116799G		ROD,THREADED 3/4X18,G5,G		12.00
						4		603670B		ANCHOR,MP-3,PT KIT,3/4X6 1/2 HOR		2.00
						5		115420B		INSTRUCTIONS,PCMB ANCHOR ASSY.		1.00



- NOTE:
1. THE REINFORCEMENT SHOWN IN DETAIL "A", IS RECOMMENDED FOR PORTABLE IN CONCRETE BARRIER TO ENSURE ADEQUATE BARRIER INTEGRITY WHEN USED IN COMBINATION WITH THE QUADGUARD SYSTEM. THE DETAIL SHOWN IS BASED ON STATE OF CALIFORNIA STANDARD PLANS FOR TEMPORARY RAILING (TYPE K). VARIATIONS MAY BE REVIEWED AND DETERMINATIONS MADE AS TO REASONABLE EQUIVALENCE BY PROJECT ENGINEER.
 2. USE ANCHOR PLATE AS TEMPLATE FOR DRILLING.
 3. RECOMMENDED HOLE DEPTH INTO PCMB IS 127[5.00]. DRILL 4 HOLES IF NECESSARY TO INSTALL A MINIMUM OF 2 ANCHOR BOLTS PER BRACKET. FINAL TORQUE TO BE 163 kN[120 ft-lbs] (TYP).
 4. IMPACT FORCES CAN BE TRANSFERRED INTO TERMINAL END OF THE BARRIER. ADEQUATE ANCHORAGE IS REQUIRED TO ENSURE PROPER IMPACT PERFORMANCE. PCMB MUST BE ANCHORED TO A RIGID SURFACE (NOT DIRT) WITH A MINIMUM OF 12 THREADED RODS (ITEM 3) AS SHOWN. ANCHOR BOTH SIDES OF BARRIER USING ITEM 1 (6 REQUIRED). ATTACH PCMB USING ONE OF THE FOLLOWING:
 - a. 1 1/2" STUDS MAY BE USED TO ANCHOR PCMB TO 28 MPa [4000 PSI] MIN. P.C. CONCRETE PER THE FOLLOWING MINIMUM CONCRETE DEPTHS:**
 - b. 150 [6.00] NON-REINFORCED ROADWAY.
 - c. 180 [7.00] DECK STRUCTURE.
 - d. 18" THREADED RODS MAY BE USED TO ANCHOR PCMB TO ASPHALT (6" MIN. THICKNESS)**.
 - e. MIN. 28 MPa [4,000 PSI] P.C. CONCRETE MEDIAN BARRIER.
 5. DIMENSIONS ARE IN MILLIMETERS [INCHES] UNLESS OTHERWISE NOTED.

**REFER TO THE QUADGUARD CZ MP-3 ANCHORING SYSTEM INSTALLATION INSTRUCTIONS FOR SPECIFICATIONS.

SECTION A-A

ASSEMBLY NO. 603648B
ASSEMBLY NO. 612006B

REFERENCES		DATE	BY
ENERGY ABSORPTION SYSTEMS, INC. ENGINEERING AND RESEARCH DEPARTMENT		7/31/97	J. Espinoza
QUADGUARD™ SYSTEM PCMB ANCHOR ASSEMBLY		11/07/96	S. Turner
INSTRUCTION NUMBER 115420B		9/12/97	KRM
N.T.S.		9/17/97	SPT
612006.dwg			
NEXT ASSEMBLY			

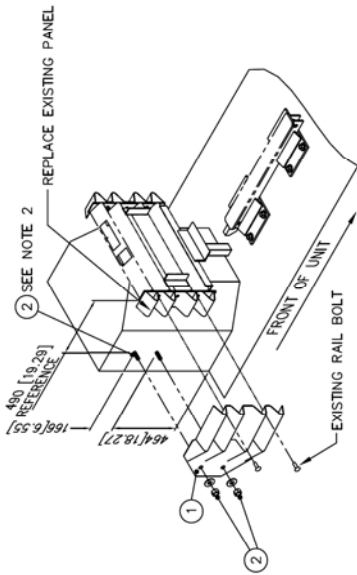
PCMB Anchor Assembly

INSTRUCTION NUMBER 115420B
N.T.S.
612006
1 of 1
D

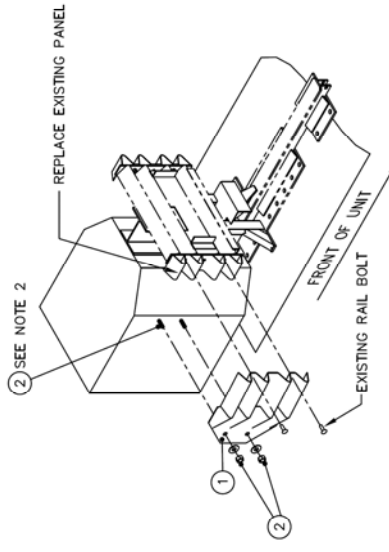
608105

PARTS LIST		
ITEM	STOCK NO.	DESCRIPTION
1	608122G	SIDE PANEL/END SHOE, QG, G
2	603670B	ANCHOR, MP-3, PT KIT, 3/4X6 1/2 HOR

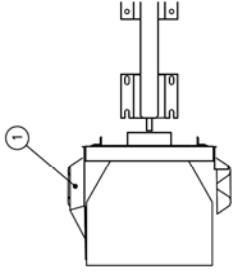
RECD	RECD
1.00	1.00
1.00	1.00



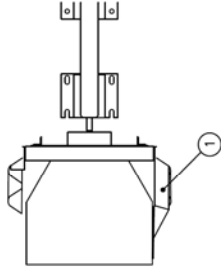
CONCRETE BACKUP



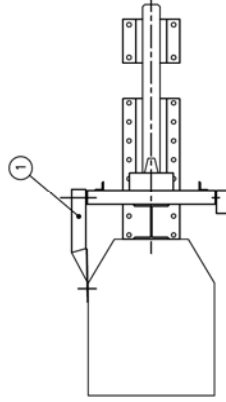
TENSION STRUT BACKUP



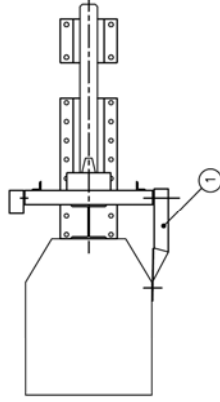
RIGHT SIDE APPLICATION



LEFT SIDE APPLICATION



RIGHT SIDE APPLICATION



LEFT SIDE APPLICATION

NOTES:
 1. DIMENSIONS ARE IN MILLIMETERS [INCHES]
 2. USE END SHOE AS TEMPLATE FOR DRILLING.
 RECOMMENDED HOLE DEPTH 127 [5.00]
 FINAL TORQUE TO BE 163Nm [120 FT-LBS] (TYP).
 ANCHOR STUD END SHOULD BE FLUSH WITH
 OUTSIDE SURFACE OF ANCHOR NUT.

REFERENCES

DRAWN	DATE
D. Staus	5/24/96
WCK	5/1/96
DESIGNED	
S. Trageser	6/5/96
APPROVED	
W. Krage	6/5/96
LDW FILE	608105.dwg

ASSEMBLY NO. 608105B

ENERGY ABSORPTION SYSTEMS, INC.
 ENGINEERING AND RESEARCH DEPARTMENT

QUADGUARD® SYSTEM
 END SHOE ASSY, QG

SCALE	N.T.S.	DATE	NO.	PAGE	REV
			608105	1 of 1	1

End Shoe Assembly

616041

PARTS LIST			
ITEM	STOCK NO.	DESCRIPTION	QTY.
1	SEE TABLE	PANEL TRANS. 4 OFFSET LOG	1.00
2	606572	BRACKET SUPPORT 4 TRANS TO CMB, Q.G.G	1.00
3	603670	ANCHOR, MP-3, PT KIT, 3/4X6 1/2 HOR	1.00
4	003400	BOLT, RAIL, 5/8X2 G	3.00
5	003340	NUT, H.X, 5/8 G, RAIL	3.00

MANUFACTURER RECOMMENDS TO REINFORCE
A MIN. OF 2450 (60.00) OF BARRIER

DETAIL A
FREE END REINFORCEMENT (SEE NOTES 1, 3 & 5)
REPLACE SIDE PANEL PIN 611888 WITH TRANSITION PANEL (ITEM 1). SEE DETAIL C

DETAIL B
CORRECT / INCORRECT
CAUTION: 20.10 (78) MAX. FOR PROPER IMPACT PERFORMANCE

DETAIL C
BACKUP DIAPHRAGM, FENDER PANEL OVERLAP, GAP, GRADE

LEFT SIDE APPLICATION
5/8 X 2 RAIL BOLT (SEE BACKUP ASSY)
102 (4.00) MI. EDGE DISTANCE
102 (4.00) MI. EDGE DISTANCE
102 (4.00) MI. EDGE DISTANCE

RIGHT SIDE APPLICATION
5/8 X 2 RAIL BOLT (SEE BACKUP ASSY)
102 (4.00) MI. EDGE DISTANCE
102 (4.00) MI. EDGE DISTANCE
102 (4.00) MI. EDGE DISTANCE

NOTES:

- THE CONCRETE BARRIER REINFORCEMENT SHOWN IN DETAIL "A" IS RECOMMENDED TO ENSURE ADEQUATE BARRIER INTEGRITY FOR PROPER IMPACT PERFORMANCE. IT IS APPROPRIATE FOR A STANDARD SAFETY SHAPED BARRIER WITH A 610 (24.00) BASE AND A 150 (6.00) TOP. VARIATIONS MAY BE REVIEWED AND DETERMINATIONS MADE AS TO REASONABLE EQUIVALENCE BY PROJECT ENGINEER.
- USE TRANSITION PANEL AS TEMPLATE FOR DRILLING. RECOMMENDED HOLE DEPTH 127 (5.00). FINAL TORQUE TO BE 165NM (120 FT-LBS) (TYP).
- IF USING ANCHOR NUTS, THE ANCHOR NUTS SHOULD BE FLUSH WITH OUTSIDE SURFACE OF ANCHOR NUT. SEE DETAIL B.
- ANCHOR STUD END SHOULD BE FLUSH WITH OUTSIDE SURFACE OF ANCHOR NUT. SEE DETAIL B.
- MIN. 27.6 MPa (4000 PSI) ± C. CONCRETE MEDIAN BARRIER.

TABLE - ITEM 1

APPLICATION	PART NO.	DESCRIPTION
LEFT SIDE	611963	PANEL TRANSITION 4 OFFSET LOG
RIGHT SIDE	611967	PANEL TRANSITION 4 OFFSET LOG

REVISIONS:

NO.	DATE	BY	DESCRIPTION
1	8/27/1996	J. Espinoza	ISSUED
2	8/27/1996	S. Turner	UNLESS OTHERWISE NOTED, ALL DIMENSIONS ARE IN MILLIMETERS (DIMENSIONS ACCORDING TO SPECIFICATIONS)

DO NOT SCALE DRAWING

LEFT ASSEMBLY NO. 616041
RIGHT ASSEMBLY NO. 616044

TRINITY HIGHWAY PRODUCTS
CORPORATE OFFICE: 10000 W. 10TH AVENUE, DENVER, CO 80201
TELEPHONE: 303.440.1000
FAX: 303.440.1001
WWW.TRINITYHIGHWAY.COM

TRANSITION ASSY, 4 OFFSET, QG

616041

1 of 1

4" Offset Transition Assembly

35-40-22 - 1 of 2

PARTS LIST		REQ'D				
ITEM	STOCK NO.	DESCRIPTION	N	M	W	48
1	611985	QuadGuard™ TO THRIE-BEAM TRANS. PANL	1	1	1	1
2	605338	DIAGONAL BRACE	1	1	1	1
3	003400	BOLT TRAIL 5/8X2.G	4	6	6	6
4	003340	NUT, HX, 5/8, G, RAIL	4	6	6	6
5	117976	WASHER, BAR, 1/8X1.1/4X2.W/HOLE	2	2	2	2
6	605334	BRACE BLOCKOUT 3.0G.G	0	1	0	0
7	605335	BRACE BLOCKOUT 1.6.0G.G	0	0	1	0
8	605333	BRACE BLOCKOUT 1.2.0G.G	0	0	0	1

SYSTEM WIDTH	ASSEMBLY #	BLOCKOUT
610 [24.00]	N 616103	NOT REQ'D
762 [30.00]	M 616102	ITEM #6*
914 [36.00]	W 616104	ITEM #7*
1219 [48.00]	48 616105	ITEM #8*

*SEE PARTS LIST ABOVE FOR QTY REQ'D

DETAIL A
FINAL CONFIGURATION OF DIAGONAL BRACE FOR MEDIUM & WIDE (762[30.00] OR 914[36.00]) SYSTEMS

DETAIL A
FINAL CONFIGURATION OF DIAGONAL BRACE FOR NARROW (610[24.00]) SYSTEMS

DIAGONAL BRACE ASSEMBLY

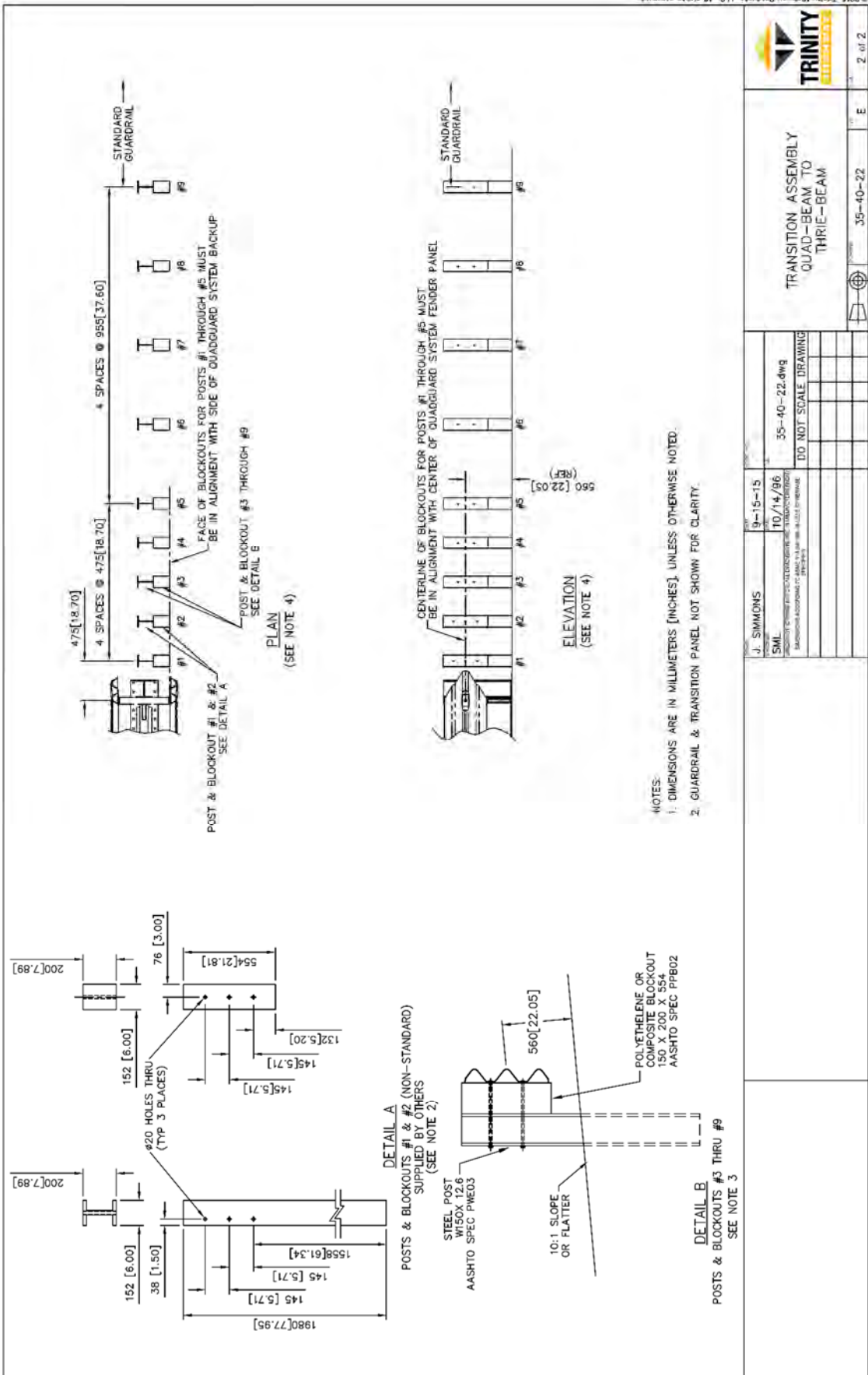
NOTES:

- PANEL OVERLAP SHOWN IS FOR TRAFFIC DIRECTION SHOWN. ACTUAL OVERLAP SHALL BE DETERMINED BY THE SITE CONDITIONS AND PROJECT ENGINEER PER TRAFFIC DIRECTION. USE STANDARD GUARDRAIL CONNECTION.
- USE STANDARD GUARDRAIL CONNECTION. ASSEMBLY MAY BE USED ON EITHER OR BOTH SIDES FOR LEFT, RIGHT, MEDIAN OR GORE APPLICATIONS. SEE NOTE 1.
- THIS ASSEMBLY IS NOT INCLUDED IN THE MODEL NUMBER AND MUST BE ORDERED SEPARATELY.
- ENERGY ABSORPTION SYSTEMS, INC. SUPPLIES THE STOCK ITEMS SHOWN IN THE PARTS LIST. ALL OTHER COMPONENTS OF THE DOWNSTREAM GUARDRAIL ARE STANDARD HIGHWAY HIGHWAYS. ITEMS MAY BE OBTAINED FROM YOUR LOCAL HIGHWAYS DEPARTMENT.
- TRANSITION AND GUARDRAIL PANEL CONNECTIONS MAY BE SLOTTED IN ORDER TO ACCOMMODATE THERMAL EXPANSION AND CONTRACTION.
- REPLACE SIDE PANEL WITH TRANSITION PANEL (ITEM 1) P.N. 2760141-0000
- SEE DIAGONAL BRACE ASSEMBLY & DETAIL A
- ALL OTHERS TO BE STANDARD AASHTO SEE NOTE 3
- POST #1 IS NOT BOLTED DIRECTLY TO TRANSITION PANEL. COUNTERSINK HOLES AS NEEDED

DESIGNED BY	T. BUSSE	DATE	9/23/96
DRAWN BY	SML	DATE	10/14/96
CHECKED BY		DATE	
APPROVED BY		DATE	
PROJECT NO.	35-40-22.dwg		
TITLE	DO NOT SCALE DRAWING		
SCALE			
DATE			
BY			
CHECKED			
APPROVED			

TRANSITION ASSEMBLY QUAD-BEAM TO THRIE BEAM	35-40-22	E
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TRINITY HIGHWAY PRODUCTS, LLC
 1 of 2



TRINITY
HIGHWAY PRODUCTS

2 of 2

35-40-22

J. SIMMONS	9-15-15	
SML	10/14/16	35-40-22.dwg
DO NOT SCALE DRAWING		

Notes:

Notes:



TRINITY

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Ahead of the Curve[®]

For more complete information on Trinity Highway products and services, visit us on the web at www.trinityhighway.com. Materials and specifications are subject to change without notice. Please contact Trinity Highway to confirm that you are referring to the most current instructions.

www.trinityhighway.com

888.323.6374 (USA)

+1 214.589.8140 (International)

QuadGuard[®] II

Assembly Manual



TRINITY
HIGHWAY

Ahead of the Curve[®]

QuadGuard® II

The QuadGuard® II has been tested pursuant to National Cooperative Highway Research Program (“NCHRP”) Report 350 specifications. The QuadGuard® II has been deemed eligible for federal-aid reimbursement on the National Highway System by the Federal Highway Administration (“FHWA”).

Assembly Manual



2525 N. Stemmons Freeway
Dallas, Texas 75207



Warning: The local highway authority, distributors, owners, contractors, lessors, and lessees are **RESPONSIBLE** for the assembly, maintenance, and repair of the QuadGuard® II. Failure to fulfill these **RESPONSIBILITIES** with respect to the assembly, maintenance, and repair of the QuadGuard® II system could result in serious injury or death.



Important: These instructions are for standard assembly specified by the appropriate highway authority. In the event the specified system assembly, maintenance, or repair would require a deviation from standard assembly parameters, contact a Trinity Highway representative. This system has been deemed eligible by the FHWA for use on the national highway system under strict criteria utilized by that agency.

This manual must be available to the worker overseeing and/or assembling the product at all times. For additional copies, contact Trinity Highway directly at (888) 323-6374 or visit trinityhighway.com.

The instructions contained in this manual supersede all previous information and manuals. All information, illustrations, and specifications in this manual are based on the latest QuadGuard® II information available to Trinity Highway at the time of printing. We reserve the right to make changes at any time. Please contact Trinity Highway to confirm that you are referring to the most current instructions.

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Customer Service Contacts

Trinity Highway is committed to the highest level of customer service. Feedback regarding the QuadGuard® II, its assembly procedures, supporting documentation, and performance is always welcome. Additional information can be obtained from the contact information below:

Trinity Highway

Telephone:	(888) 323-6374 (USA) +1 214 589-8140 (International)
E-mail:	product.info@trin.net
Website:	trinityhighway.com

Important Introductory Notes

The performance of the QuadGuard® II as designed, and approved for reimbursement by the FHWA pursuant to its NCHRP Report 350 standard, is dependent upon the proper assembly, deployment and future maintenance of the system. These instructions must be read in their entirety and understood before assembling the QuadGuard® II. These instructions are to be used in conjunction with the assembly of QuadGuard® II and are for standard assemblies only as specified by the applicable highway authority. If you need additional information, or have questions about the QuadGuard® II, please contact the highway authority that has planned and specified this assembly and, if needed, contact Trinity Highway Customer Service. This product must be assembled in the location specified by the appropriate highway authority. If there are deviations, alterations, or departures from the assembly instructions specified in this manual, the device may not perform as tested.



Important: DO NOT use any component part that has not been specifically specified herein for the QuadGuard® II during the assembly or repair (pp. 7 – 11 / 63 - 64).

This product has been specified for use by the appropriate highway authority and has been provided to that user who has unique knowledge of how this system is to be assembled. No person should be permitted to assemble, maintain, or repair this system that does not possess the unique knowledge described herein. These instructions are intended for an individual qualified to both read and accurately interpret them as written. These instructions are intended only for an individual experienced and skilled in the assembly of highway products that are specified and selected by the highway authority.

A manufacturer's drawing package will be supplied by Trinity Highway upon request. Each system will be supplied with a specific drawing package unique to that system. Such drawings take precedence over information in this manual and shall be studied thoroughly by a qualified individual who is skilled in interpreting them before the start of any product assembly.

Safety Symbols

This section describes the safety symbols that appear in this manual. Read the manual for complete safety, assembly, operating, maintenance, repair, and service information.

Symbol

Meaning



Safety Alert Symbol: Indicates Important, Caution, Warning, or Danger. Failure to read and follow the Important, Caution, Warning, or Danger indicators could result in serious injury or death to the workers and/or bystanders.



Warning: Read safety instructions thoroughly and follow the assembly directions and suggested safe practices before assembling, maintaining, or repairing the QuadGuard® II. It is the responsibility of the installer to follow these warnings. Failure to comply with these warnings could result in increased risk of serious injury or death in the event of a vehicle impact with a system.



Important: Please keep up-to-date instructions for later use and reference by anyone involved in the assembly of the product.

Safety Rules for Assembly

*** Important Safety Instructions ***

This manual must be kept in a location where it is readily available to persons who are skilled and experienced in the assembly, maintenance, or repair of the QuadGuard® II. Additional copies of this manual are available from Trinity Highway by calling (888) 323-6374, or by email at product.info@trin.net, or at trinityhighway.com. Please contact Trinity Highway if you have any questions concerning the information in this manual or about the QuadGuard® II.

It is the responsibility of the installer to use appropriate safety precautions when operating power equipment, mixing chemicals, and when moving heavy equipment or QuadGuard® II components. Safety articles including but not necessarily limited to work gloves, eye protection, safety-toe shoes, and back support should be used.



Warning: It is the responsibility of the installer to use all safety measures incorporating appropriate traffic control devices specified by the highway authority. These measures must be used to protect all personnel while at the assembly, maintenance, or repair site.



Warning: Failure to comply with these warnings could result in increased risk of serious injury or death in the event of a vehicle impact with a system that has not been accepted by the FHWA.



Warning: Use only Trinity Highway parts on the QuadGuard® II for assembly, maintenance, or repair. The use of component parts not specified herein is **strictly prohibited**. The QuadGuard® II assembled with Trinity Highway parts has been tested, approved, and accepted for state use by the FHWA. A QuadGuard® II using parts other than those specified herein has not been tested, approved, or accepted for state use by the FHWA. Failure to follow this warning could result in increased risk of serious injury or death in the event of a vehicle impact.

Limitations and Warnings

Trinity Highway contracts with FHWA approved testing facilities to perform crash tests, evaluate test results, and submit results to the FHWA for review.

The QuadGuard® II has been deemed eligible for reimbursement by FHWA as meeting the requirements and guidelines of NCHRP Report 350. NCHRP Report 350 tests are designed to evaluate product performance involving a range of vehicles on roadways, from lightweight cars (approx. 1800 lb. [820 kg]) to full size pickup trucks (approx. 4400 lb. [2000 kg]). A product can be certified for multiple Test Levels. The QuadGuard® II system is certified to the Test Level(s) as shown below:

Test Level 2: 43 mph [70 km/h]

Test Level 3: 62 mph [100 km/h]

These FHWA directed tests are not intended to represent the performance of systems when impacted by every vehicle type or every impact condition existing on the roadway. This system is tested only to the test matrix criteria of NCHRP Report 350 as approved by FHWA.

Trinity Highway expressly disclaims any warranty or liability for injury or damage to persons or property resulting from any impact, collision or harmful contact with products, other vehicles, or nearby hazards or objects by any vehicle, object or person, whether or not the products were assembled in consultation with Trinity Highway or by third parties.

The QuadGuard® II is intended to be assembled, delineated, and maintained within specific state and federal guidelines. It is important for the highway authority specifying the use of a highway product to select the most appropriate product configuration for its site specifications. The customer should be careful to properly select, assemble, and maintain the product. Site lay out, vehicle population type; speed, traffic direction, and visibility are important elements that require evaluation in the selection of a highway product. For example, curbs could cause an untested effect on an impacting vehicle.

After an impact occurs, the debris from the impact should be removed from the area immediately and the specified highway product should be evaluated and restored to its original specified condition or replaced as the highway authority determines as soon as possible.



Warning: Do not assemble, maintain, or repair the QuadGuard® II until you have read this manual thoroughly and completely understand it. Ensure that all Danger, Warning, Caution, and Important statements within the manual are completely followed. Please call Trinity Highway at (888) 323-6374 if you do not understand these instructions.



Warning: Ensure that all of the QuadGuard® II Danger, Warning, Caution, and Important statements within the QuadGuard® II manual are completely followed. Failure to follow this warning could result in serious injury or death in the event of a collision.

System Overview

The QuadGuard® II is a re-directive, non-gating crash cushion for roadside obstacles ranging in width from 24" to 126" (610 mm to 3200 mm). It consists of energy-absorbing cartridges surrounded by a framework of Quad-Beam Panels.



Important: Trinity Highway makes no recommendation whether use or reuse of any part of the system is appropriate or acceptable following an impact. It is the sole responsibility of the project engineer and/or the local highway authority and its engineers to make that determination. It is critical that you inspect this product after assembly is complete to make certain that the instructions provided in this manual have been strictly followed.

The QuadGuard® II utilizes two types of cartridges in a staged configuration designed to address both lighter cars and heavier, high center-of-gravity vehicles. Its modular design allows the system length to be tailored to the design speed of a site.

Impact Performance

The 5 Bay QuadGuard® II has successfully passed the requirements outlined in NCHRP Report 350, Test Level 3 tests with both the light car and pickup at speeds of up to 62 mph [100 km/h] at angles up to 20 degrees.

During head-on impact testing, within NCHRP Report 350 criteria, the QuadGuard® II is designed to telescope rearward to absorb the energy of impact. When impacted from the side, within the applicable NCHRP Report 350 criteria, it is designed to redirect the vehicle back toward its original travel path and away from the roadside obstacle.



Warning: Do not modify the QuadGuard® II in any way.



Warning: It is the responsibility of the project engineer and / or local highway authority and its engineer to ensure that the QuadGuard® II and delineation used meet all federal, state, specifying agency, and local specifications.



Warning: It is the responsibility of the project engineer and / or local highway authority and its engineer to ensure delineation on the assembly meets all appropriate Manual on Uniform Traffic Control Devices ("MUTCD") and local standards.

Inspect Shipping

Before deploying the QuadGuard® II, check the received parts against the shipping list supplied with the system. Make sure all parts have been received.



Important: The Manufacturer's Drawing Package supplied with the QuadGuard® II must be used with these instructions for proper assembly and should take precedence over these general instructions.

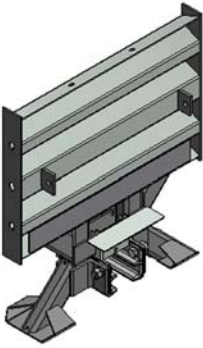
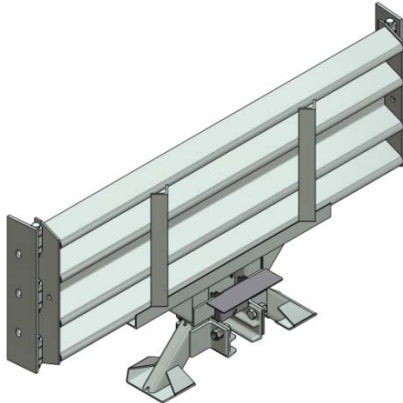
System Components

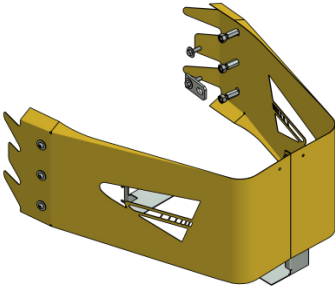
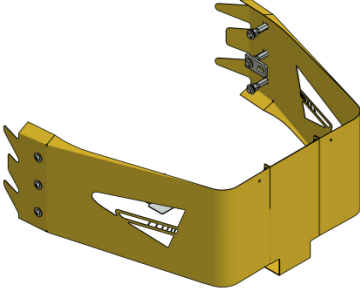
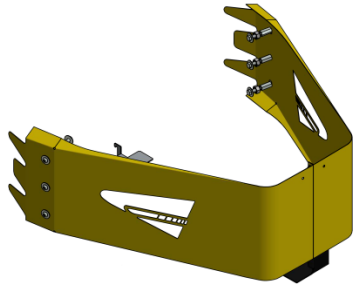
Below is a list of system components to be used in the repair of your particular QuadGuard® II configuration. Please call Trinity Highway customer support if you have any system questions (p. 3).



Warning: Use only Trinity Highway parts that are specified herein for the QuadGuard® II for assembling, maintaining, or repairing the QuadGuard® II. **Do not utilize or otherwise comingle parts from other systems even if those systems are other Trinity Highway systems.** Such configurations have not been tested, nor have they been deemed eligible for use. Assembly, maintenance, or repairs using unspecified parts or accessories is strictly prohibited.

Note: Components are not shown to scale.

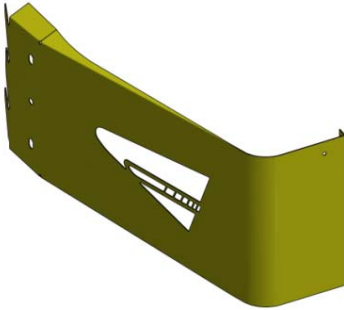
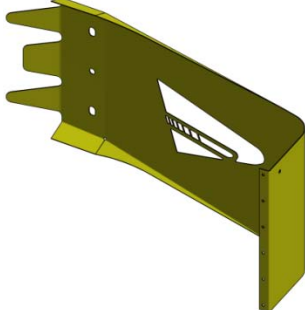
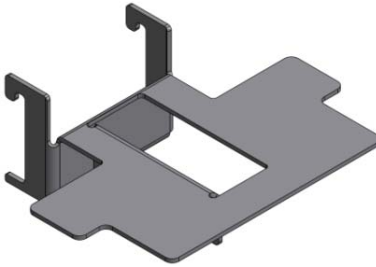
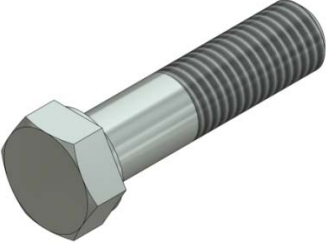
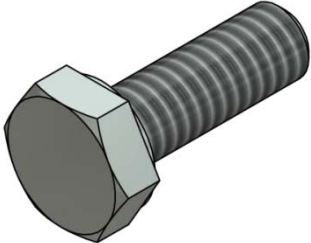

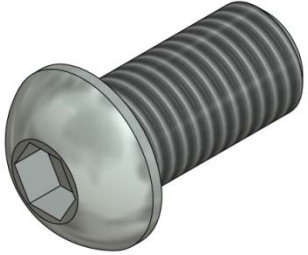
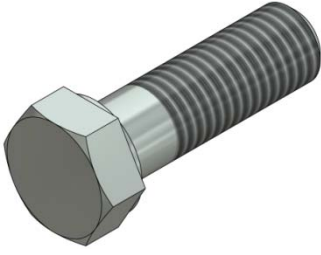

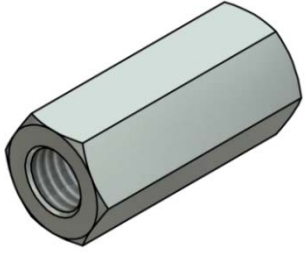


Narrow Diaphragm Assemblies *	Wide Diaphragm Assemblies *		
 625650 - 24" 625651 - 30" 625652 - 36" 606810 - 48"	 607173 - 26.48" 607174 - 29.65" 607175 - 32.78" 607176 - 35.93" 607177 - 39.08" 607145 - 42.23" 607146 - 45.38"	 607148 - 48.53" 607149 - 50.11" 607150 - 51.68" 607151 - 54.83" 607152 - 57.98" 607156 - 59.56"	 607157 - 61.13" 607158 - 64.28" 607159 - 68.06" 607160 - 70.58" 607162 - 73.73" 607163 - 76.88" 607164 - 80.04"

Nose, Narrow Assembly *	Nose, Narrow Assembly 48" *	Nose, Wide Assembly *
 611580 - Galvanized 611581 - Yellow 611579 - Black	 611577 - Galvanized 611578 - Yellow 611576 - Black	 611583 - Galvanized 611584 - Yellow 611582 - Black

* Assemblies include multiple parts.

<p>Mushroom Washer</p>  <p>617045</p>	<p>Flat Screw 5/8X8 1/2" Wide</p>  <p>116879</p>	<p>Die Spring, 6", Wide</p>  <p>117458</p>
<p>Flat Screw 5/8X5", G8, Narrow</p>  <p>116878</p>	<p>Die Spring, 1 1/2", Narrow</p>  <p>117459</p>	<p>Rail Nut, Hex, 5/8"</p>  <p>003340</p>
<p>Rail Bolt, 5/8X2"</p>  <p>003400</p>	<p>Panel, Fender Assembly, QG</p>  <p>608236</p>	<p>Washer, Flat, 5/8" X 1 3/4"</p>  <p>003300</p>
<p>Nose, L, Wide, W/Logo</p>  <p>611672</p>	<p>Nose, R, Wide, W/Logo</p>  <p>611683</p>	<p>Bracket, Cart Support, Nose</p>  <p>605430</p>

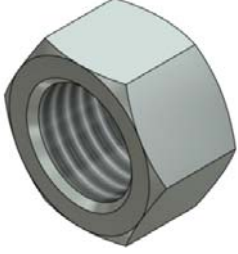

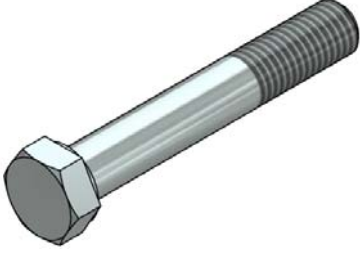


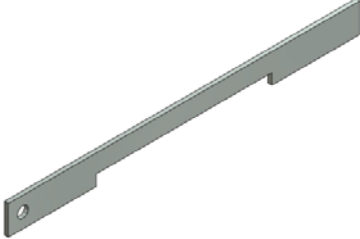
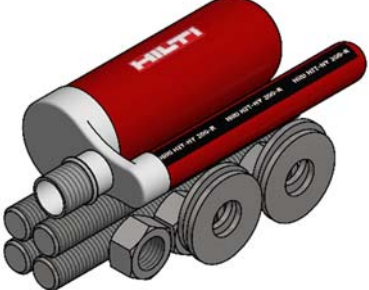

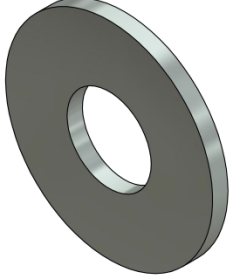
* Parts in red are included in assemblies.

<p>Nose, L, Narrow, W/Logo</p> 	<p>Nose, R, Narrow, W/Logo</p> 	<p>Bracket, Cart, Nose</p> 
<p>611669</p>	<p>611680</p>	<p>605420</p>
<p>Bolt, Hex, 5/8" X 2 1/2", G5</p> 	<p>Bolt, Hex, 1/4" X 3/4", G5</p> 	<p>Bracket, Cartridge Support</p> 
<p>118232</p>	<p>113518</p>	<p>605446</p>
<p>Bolt, Bt, 5/8" X 1 1/4", Hex Socket</p> 	<p>Bolt, Hex, 5/8" X 2", G5</p> 	<p>Nut, Hex, 1/4"</p> 
<p>113404</p>	<p>118570</p>	<p>115946</p>
<p>Nut, Hex, Coupling, 5/8" 11" X 2 1/8"</p> 	<p>Washer, Lock, 1/4"</p> 	<p>Washer, Lock, 5/8"</p> 
<p>115986</p>	<p>118085</p>	<p>118100</p>



* Parts in red are included in assemblies.

<p>Bracket, Angle, 2" X 1", W/Holes</p>  <p>617387</p>	<p>Washer, Flat 3/8" X 1"</p>  <p>118036</p>	<p>Nut, Hex, 3/8"</p>  <p>115960</p>
<p>Bolt, Hex, 3/8" X 1", G5</p>  <p>113596</p>	<p>Washer, Fender, 3/8" X 2"</p>  <p>118038</p>	<p>Bolt, Hex, 5/8" X 1 1/2", G5</p>  <p>113654</p>
<p>Bracket, Pull-Out</p>  <p>605535</p>	<p>Shim Kit, 1/8" X 3 5/8" X 8"(2)</p>  <p>614050</p>	<p>Washer, Lock, 3/4"</p>  <p>118089</p>
<p>Bolt, Hex, 3/4" X 2", G8</p>  <p>113555</p>	<p>Monorail Guide</p>  <p>611368</p>	<p>Nut, Heavy Hex, 3/4"</p>  <p>003704</p>

* Parts in red are included in assemblies.

<p>Nut, Heavy Hex, 5/8"</p> 	<p>Hinge Plate, Fender Panel</p> 	<p>Bolt, Hex, 5/8" X 4", G5</p> 
<p>003354</p>	<p>610172</p>	<p>113666</p>
<p>Panel, Side, QG</p> 	<p>Bracket, Cartridge Support TS B/U</p> 	<p>Locking Bar, Cartridge Support</p> 
<p>611898</p>	<p>605447</p>	<p>611266</p>
<p>Anchor Kit, Hilti, 3/4" X 7" (4) *</p> 	<p>Stud, 3/4" X 7", G5</p> 	<p>Washer, Flat, 3/4" X 2"</p> 
<p>619316</p>	<p>117542</p>	<p>118027</p>

*See Trinity Highway Approved Adhesive Anchoring System section on page 16.

<p>Cartridge Assy, Type I</p> 	<p>Cartridge Assy, Type II</p> 
<p>606027</p>	<p>606029</p>

* Parts in red are included in assemblies.

Foundation/Anchoring



Important: It is the responsibility of the local DOT or appropriate authority to ensure this assembly conforms to the AASHTO Roadside Design Guide.



Warning: It is the responsibility of the installer to ensure that your assembly procedure meets all appropriate Occupational Safety and Health Administration (OSHA) and local standards.

Asphalt Installations

QuadGuard® II Narrow systems with a Tension-Strut Backup may be temporarily installed in construction zones on asphalt. Assemblies on Asphalt Concrete (“**A.C.**”) must provide a minimum of 3” [76 mm] layer of asphalt over a minimum of 3” [76 mm] layer of **Portland Cement Concrete** (“**P.C.C.**”), 6” [152 mm] layer of asphalt over 6” [152 mm] layer of subbase, or 8” [203 mm] layer of asphalt with no subbase.



Important: Only 18” [460 mm] threaded rods, utilizing Trinity Highway approved adhesive, can be used with asphalt foundations. Contact Customer Service for a complete list of approved adhesives (p. 3).

Concrete Installations

For concrete installations, the QuadGuard® II should be installed only on an existing or freshly placed and cured concrete base (4000 psi [28 MPa] minimum). Orientation of the concrete base and the attenuator must comply with the project plans or as otherwise determined by the project engineer or appropriate highway authority.

The QuadGuard® II may be installed on any of the following foundations using the specified anchorage:

Foundation A: Concrete Pad or Roadway

Foundation: 6” [150 mm] minimum depth P.C.C.

Anchorage: Approved adhesive with 7” [180 mm] studs 5 1/2” [140 mm] embedment

Foundation B: Asphalt over P.C.C.

Foundation: 3” [76 mm] minimum A.C. over 3” [76 mm] minimum P.C.C.

Anchorage: Length of anchor required is 18” [460 mm] 16 1/2” [420 mm] embedment

Foundation C: Asphalt over Compacted Subbase (“C.S.”)

Foundation: 6” [150 mm] minimum A.C. over 6” [150 mm] minimum **C.S.**

Anchorage: Approved adhesive with 18” [460 mm] studs 16 1/2” [420 mm] embedment

Foundation D: Asphalt Only

Foundation: 8” [200 mm] minimum A.C.

Anchorage: Approved adhesive with 18” [460 mm] studs - 16 1/2” [420 mm] embedment



Important: Systems mounted on asphalt must be replaced and mounted on fresh, undisturbed asphalt if more than 10% of anchors are found to be loose, broken, or show signs of pull out. If 10% or fewer anchors are damaged, replace the damaged anchors in the existing asphalt. Anchor bolts used on systems mounted on asphalt must be inspected every six months. See Post Impact Instructions and Maintenance and Repair instructions on page 58.

Recommended Tools

Documentation

- Manufacturer's Assembly Manual
- Manufacturer's Drawing Package

Personal Protective Equipment

- Eye Protection
- Gloves
- Safety Toe Shoes

Cutting Equipment

- Rotary Hammer Drill
- Rebar Cutting Bit
- Concrete Drill Bits – 7/8" [22 mm] (**Double-Fluted**)
- Grinder, Hacksaw or Torch (optional)
- Drill Bits 1/16" through 7/8"



Important: Trinity Highway recommends using double-fluted drill bits to achieve optimum tensile strength when applying an approved adhesive to the anchoring system (p. 16).

Hammers

- Sledgehammer
- Standard hammer

Wrenches

- Heavy Duty 1/2" drive impact wrench
- 1/2" drive Sockets: 9/16", 11/16", 3/4", 15/16", 1 1/8", 1 1/4"
- 1/2" drive Deep Well Sockets: 15/16", 1 1/4"
- 1/2" drive Ratchet and Attachments
- 1/2" drive Breaker Bar – 24" long
- 1/2" drive Torque Wrench: 200 ft-lb
- Crescent Wrench: 12" [300 mm]
- Allen Wrench: 3/8"



Important: Trinity Highway makes no recommendation whether use or reuse of any part of the system is appropriate or acceptable following an impact. It is the sole responsibility of the project engineer and/or the local highway authority and its engineers to make that determination. It is critical that you inspect this product after assembly is complete to make certain that the instructions provided in this manual have been strictly followed.

Miscellaneous

- Traffic Control Equipment
- Lifting and moving equipment (A lifting device is preferred although a forklift can be used.) Minimum 5,000 lb. capacity required.
- Air Compressor (100 psi minimum) and Generator (5 kW)
- Long Pry Bar
- Drift Pin 12" [300 mm]
- Center Punch
- Tape Measure 25' [7.5 m]
- Chalk Line
- Concrete Marking Pencil
- 7/8" Diameter steel tube brush for cleaning drilled boreholes
- Rags, water, and solvent for clean up

Note: The above list of tools is a general recommendation and should not be considered an exhaustive list. Depending on specific site conditions and the complexity of the assembly specified by the appropriate highway authority the required tools may vary. Decisions as to what tools are needed to perform the assembly properly are entirely the responsibility of the specifying highway authority and the authority's selected contractor performing the assembly of the system at the authority's specified assembly site.

Site Preparation/Foundation

A QuadGuard® II system should be assembled only on an existing or freshly placed and cured concrete base (28 MPa [4000 psi] minimum). Location and orientation of the concrete base and attenuator must comply with project plans or as otherwise determined by the local highway authority.

Recommended dimension and reinforcement specifications for new concrete foundations are provided in Trinity Highway concrete foundation drawings, supplied with the system. The system may be assembled on a non-reinforced concrete roadway (minimum 8" [200 mm] thick). Deployment cross-slope shall not exceed 8% and should not twist more than 2% over the length of the system; the foundation surface shall have a light broom finish.



Warning: It is the responsibility of the appropriate highway authority to select the location for the QuadGuard® II in accordance with the AASHTO Roadside Design Guide. Trinity Highway is not responsible for choosing the location for system placement.



Warning: Ensure proper site grading for QuadGuard® II placement as directed by the state or specifying agency pursuant to the AASHTO Roadside Design Guide.



Caution: Accurate placement of all steel rebar is critical to avoid interference with the concrete anchor bolts.

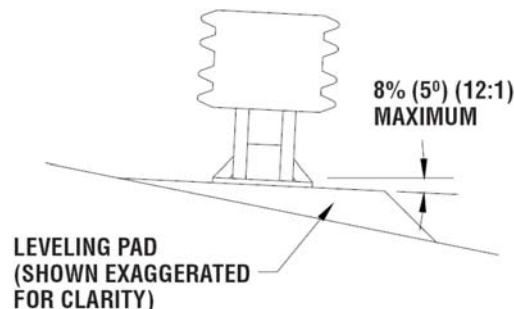


Figure 1
Cross-Slope



Warning: Location of the Backup in relation to nearby objects will affect the operation of the attenuator. Upon impact, the Fender Panels are designed to telescope rearward and extend beyond the rigid Backup as much as 30" [760 mm] from their pre-impact location. Position the Backup so that the rear ends of the last Fender Panels are a minimum of 30" [760 mm] forward of objects that would otherwise interfere with movement of the rearmost Fender Panels. Failure to comply with this requirement is likely to result in system performance that has not been crash tested pursuant to NCHRP Report 350 criteria and may also cause component damage which will necessitate maintenance or replacement of the system.



Important: It is critical that you inspect this product after assembly is complete to ensure the instructions provided in this manual have been strictly followed.

Trinity Highway Approved Adhesive Anchoring System

A Trinity Highway approved adhesive anchoring system is required to securely anchor crash cushions. Each approved adhesive kit contains adhesive, studs, nuts and washers. Both vertical and horizontal assemblies are possible using an approved adhesive anchoring system.

Vertical Assemblies

Note: Read all Trinity Highway approved adhesive instructions before starting.

1) Prepare the Concrete Foundation



Warning: Do not allow anchoring adhesive to contact skin or eyes. See safety data sheet supplied with adhesive kit for first-aid procedures. Use only in well-ventilated area. Do not use near open flame.



Warning: Wear gloves and eye protection during application.

The studs that anchor the QuadGuard® II Backup and/or Monorail sections to the concrete foundation must be those shipped in the kit or of high strength steel (120,000 psi [830 MPa] minimum tensile strength or equal). These studs must be set in minimum 4000 psi [28 MPa] concrete. Allow the concrete to cure a minimum of seven days before applying anchoring adhesive.

2) Drill Boreholes



Caution: It is the responsibility of the installer to consult OSHA silica respiratory standard 29 CFR 1910.134 for debris removal from borehole(s) and use Trinity Highway approved adhesive to achieve optimum tensile strength. Do not use diamond drill bits for drilling boreholes.

Use the Monorail(s) and Tension Strut Backup as drilling templates. Use a rotary hammer drill to drill the boreholes 7/8" [22 mm] diameter to the recommended depth. See the approved adhesive instructions provided with your kit. Check to ensure each borehole is drilled to the proper depth and aligned with the part to be anchored per chart below.

Anchoring Information					
Stud Size:	Orientation	Bit Size	Minimum Depth	Torque	Medium
3/4"x 6 1/2"	Horizontal	7/8" [22 mm]	5 1/4" [133 mm]	Manufacturer Spec	Concrete
3/4"x 7"	Vertical	7/8" [22 mm]	5 3/4" [145 mm]	Manufacturer Spec	Concrete
3/4"x 18"	Vertical	7/8" [22 mm]	16 3/4" [425 mm]	10 ft-lb [15 N-m]	Asphalt



Important: When mounting on asphalt, initial torque shall be as shown above. Due to the properties of asphalt, anchors may loosen over time. For this reason Trinity Highway recommends anchoring to asphalt only at temporary locations. It is recommended to re-torque anchors in asphalt every six (6) months to the proper initial torque specified.

3) Clean the Boreholes

Blow the concrete dust from the borehole using oil-free compressed air. Thoroughly brush it with a 7/8" diameter steel bristle tube brush and then blow it out again. If the borehole is wet, completely flush it with water while brushing and then blow it clean to remove all water using oil-free compressed air.

Note: Use of the Trinity Highway approved vacuum drilling equipment is authorized to replace the blowing and brushing requirement of Step 3.

4) Apply Approved Adhesive

Fill the borehole 100% full.



Caution: Fill borehole 100% full so it is even with the pavement surface per manufacturer's instructions.

5) Add Nuts to Anchor Studs

Place a flat washer onto the stud then thread a nut on until the end of the stud is flush with the nut (Figure 2).

6) Insert Studs in Boreholes and Wait for Adhesive to Cure

Push the stud down through the part to be anchored and into the borehole.



Caution: Do not disturb or load the stud until the approved adhesive material has hardened (see instructions supplied with the approved adhesive kit).

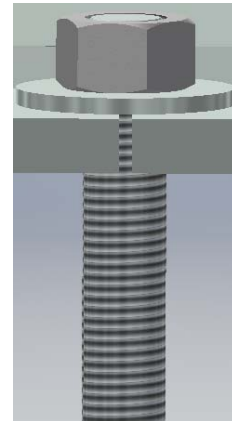


Figure 2
Vertical Application
(Before Applied Torque)

7) Torque the Nuts

Once the adhesive has fully cured, torque the nut to the adhesive manufacturer's recommended values.

Anchor Assembly Cautions

1) Steel rebar

If steel rebar is encountered while drilling an anchor bolt borehole, apply one of the following solutions:

A) Use a rebar drill bit for the **rebar only** and then switch back to the concrete bit to finish drilling into the underlying concrete until the proper borehole depth is reached.



Caution: Do not drill through rebar without first obtaining permission to do so from the project engineer.

B) Drill a new borehole down at an angle past the rebar to the proper depth. Anchor the stud by completely filling both boreholes with an approved adhesive.

Horizontal Assemblies

The horizontal approved adhesive kit is the same as the vertical kit.



Caution: Fill borehole 100% full so it is even with the surface of the hole per manufacturer's instructions.

1) Follow the instructions supplied with your approved adhesive kit

Apply approved adhesive to each anchor per instructions.

2) Add the Washers and Nuts

Put washer and nut on stud so the **nut is flush with end of stud**.

3) Insert each Stud with Washer and Nut into Borehole

Push stud with washer and nut into borehole.



Important: The stud should be flush with the top of the nut in both **vertical** and **horizontal** applications prior to tightening (Figure 3).

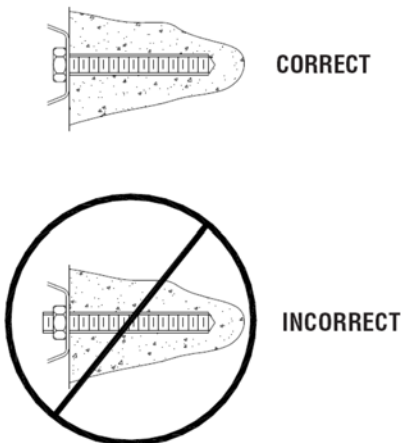


Figure 3
Horizontal Application
(Before Applied Torque)



Warning: Do not disturb or load the stud until the approved adhesive material has hardened (**see approved adhesive kit instructions for cure times and torque values**).

4) Torque the nuts

Once the adhesive has fully cured, torque nut(s) to the approved adhesive manufacturing specification.

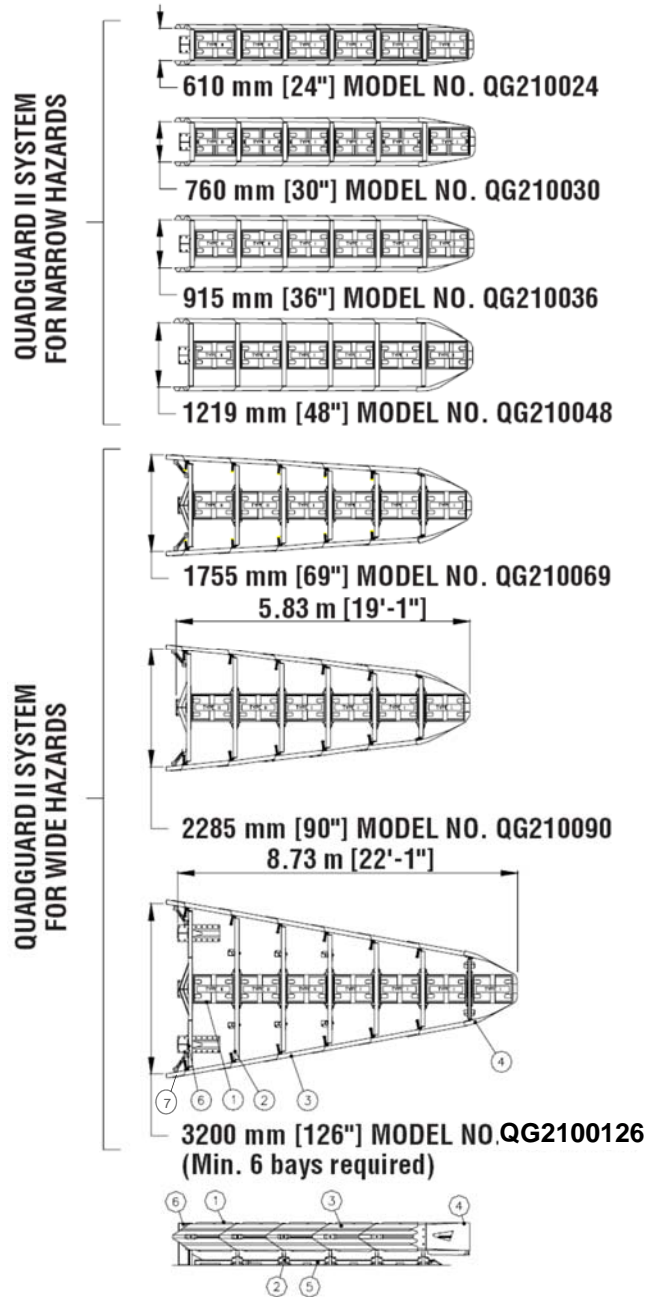


Figure 4 Plans & Elevation
 (Five Bay systems with Tension Strut Backups shown, except as noted)

Key

- 1) Cartridge
- 2) Diaphragm
- 3) Quad-Beam Fender Panel
- 4) Nose
- 5) Monorail
- 6) Backup
- 7) Side Panel

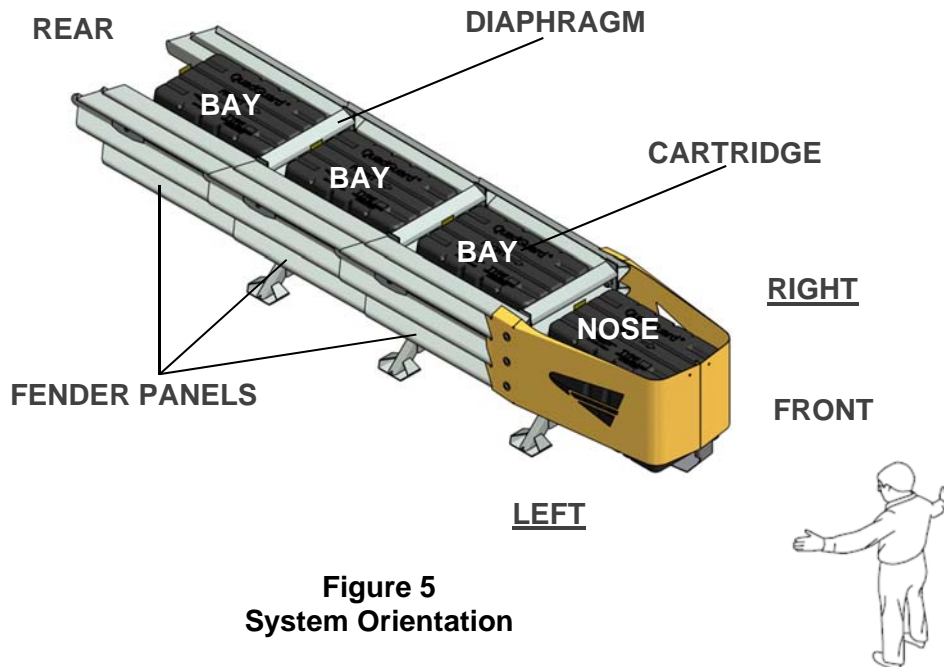
How to Determine Left/Right

To determine left from right when ordering parts, stand in front of the system facing the roadside feature. Your left is the system's left and your right is the system's right.

Counting the Number of Bays

One Bay consists of one Cartridge, one Diaphragm, two Fender Panels, etc. The Nose section is not considered a Bay, though there is a Cartridge in the Nose of each system (pp. 63 & 64).

Note: There will always be one more Cartridge in the system than the number of Bays in the system. To determine number of Bays, count Fender Panels on one side (Figure 5). The Three Bay system is shown below.



Measuring the Width

The QuadGuard® II system is available in seven (7) nominal widths:

- 24" [610 mm]
- 30" [760 mm]
- 36" [915 mm]
- 48" [1219 mm]
- 69" [1755 mm] – (Minimum 3 Bays Required)
- 90" [2285 mm] – (Minimum 3 Bays Required)
- 126" [3200 mm] – (Minimum 6 Bays Required)

The nominal width of a **Narrow (parallel)** system is the width of the Backup diaphragm (Figure 6).

The nominal width of a **Wide (flared)** system is the width at the location shown in Figure 7.

The outside or overall width of the system is approximately 6" [150 mm] to 9" [230 mm] wider than the nominal width.

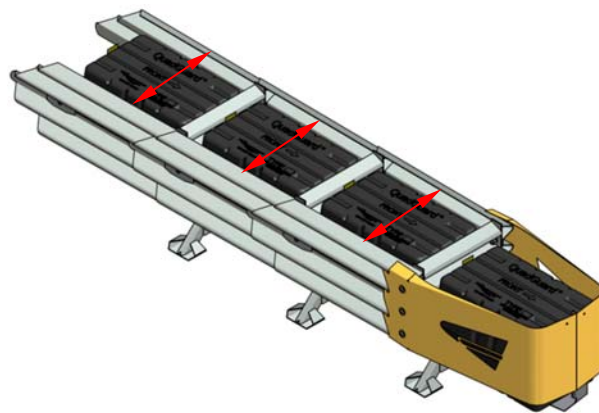


Figure 6
Narrow (Parallel) System

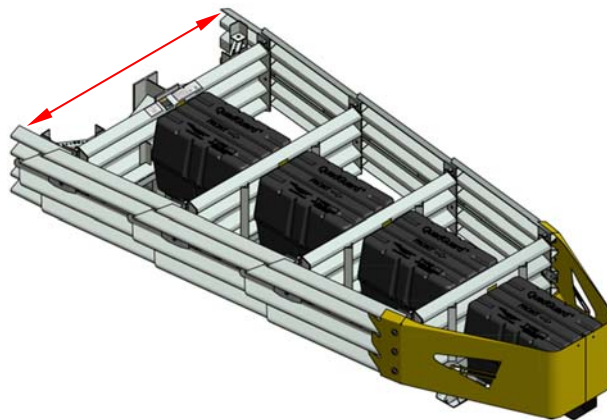


Figure 7
Wide (Flared) System

Narrow (Parallel) Systems

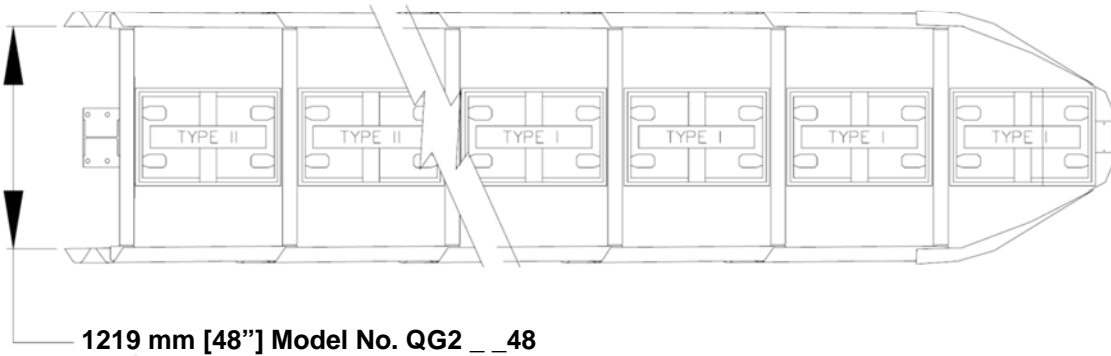
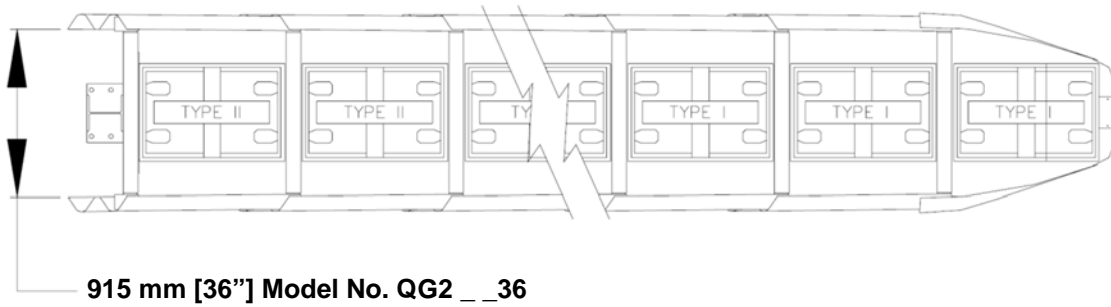
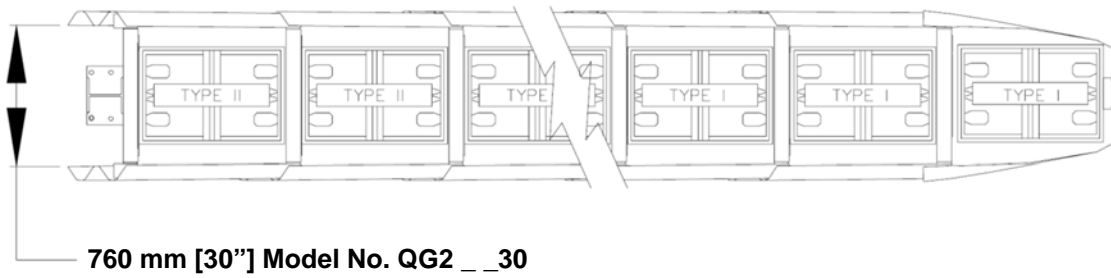
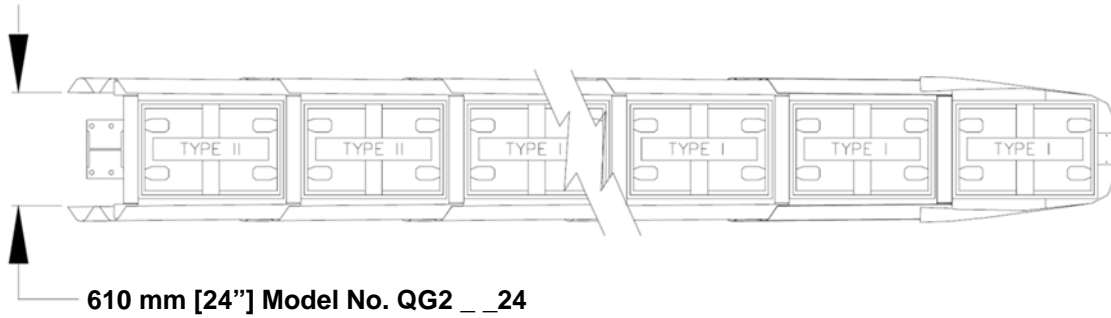


Figure 8
Narrow System(s) and Model Numbers

Assemble Narrow (Parallel)

Determine Backup and Transition Type

The QuadGuard® II is available with a Tension Strut Backup or a Concrete Backup. Refer to Figures 9 and 10, along with the Backup Assembly drawing, to determine which type of Backup is being deployed.

A Transition Panel or Side Panel must be used on each side of the Backup. A Side Panel is not needed when a Transition Panel is used. Several types of Transitions are available for use with the QuadGuard® II. Refer to Figures 11 - 16 and the Manufacturer's Drawing Package to determine which type of Panels to attach.

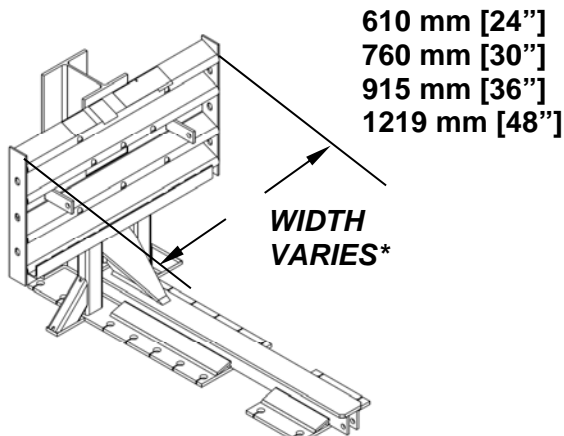


Figure 9
Tension Strut Backup

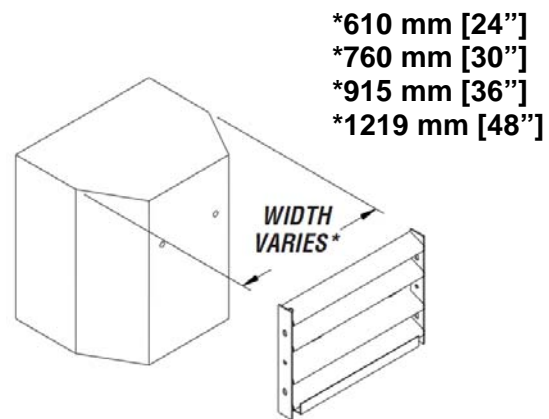


Figure 10
Concrete Backup

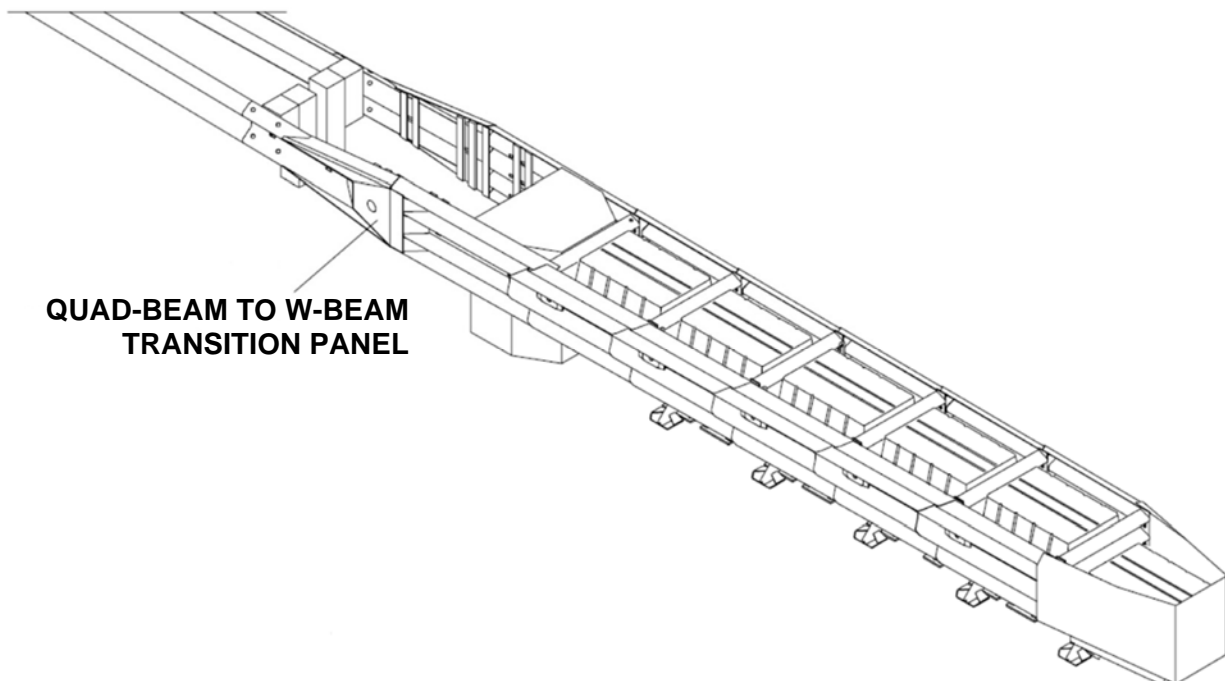


Figure 11
Transitioning the QuadGuard® II

Note: The proper Transition Panel or Side Panel must be used for impact performance of the system. The correct Panel(s) to use will depend on the direction of traffic and what type of barrier or roadside obstacle the QuadGuard® II is shielding. Contact Customer Service prior to deployment if you have any questions (p. 3).

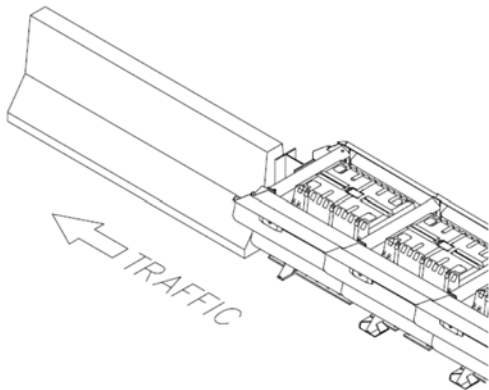


Figure 12
No Transition

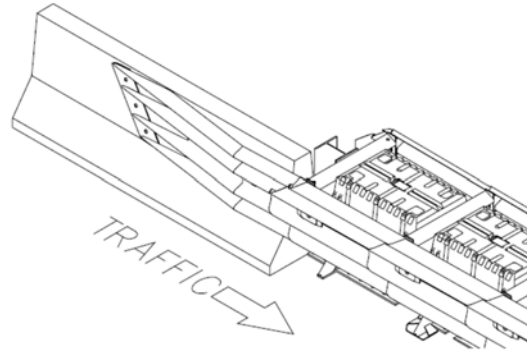


Figure 13
Quad-Beam to Safety Shape Barrier

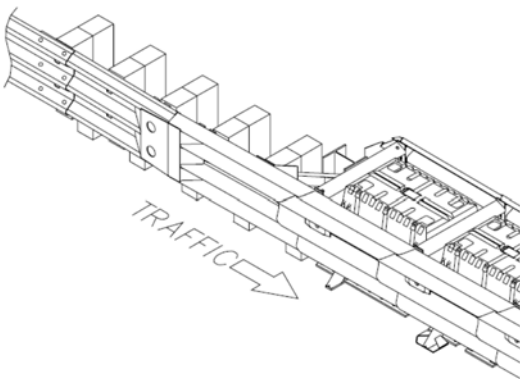


Figure 14
Quad-Beam to Thrie-Beam

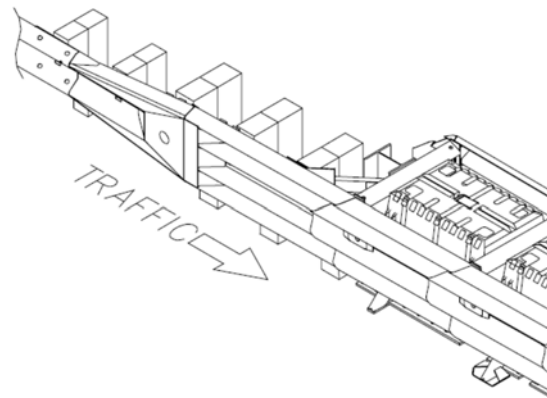


Figure 15
Quad-Beam to W-Beam

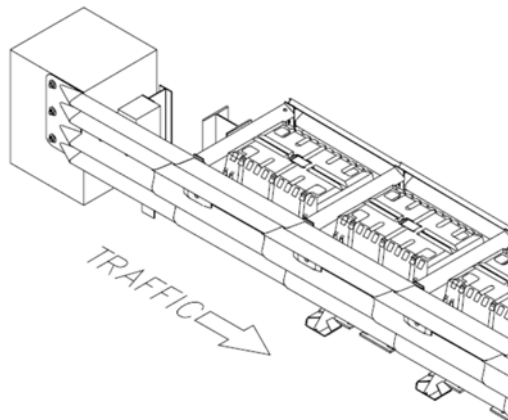


Figure 16
Quad-Beam End Shoe

1) Mark System Location

Locate the centerline of the system by measuring the proper offset from the roadside feature. See the Manufacturer's Drawing Package supplied with the system. Place chalk line to mark the centerline of the system. Mark a construction line parallel to the center line and offset 6.5" [165 mm] to one side as shown in Figure 17. The edge of the Monorail will be positioned on this line.

Note: The concrete foundation shall comply with the Manufacturer's Drawing Package supplied with the system.



Warning: Location of system with respect to the roadside obstacle is critical and dependent on the type of Transition Panel used. See the Manufacturer's Drawing Package supplied with the system for details.



Figure 17
(Top view of concrete foundation)

2) Anchor the Backup

A) Concrete Backup Construction (Figure 18)

Locate Backup Face Plate using the Backup Assembly drawing. **Verify that any applicable Transition Panels fit properly before anchoring the Face Plate.** Drill anchor boreholes in the Concrete Backup using the Face Plate as a template. Anchor the Face Plate to the Concrete Backup using an approved adhesive supplied with the QuadGuard® II (p. 16).

A Trinity Highway approved adhesive anchoring system is required to securely anchor crash cushions and other common highway devices. Each approved adhesive kit contains adhesive, studs, nuts and washers. Both vertical and horizontal assemblies are possible using an approved adhesive anchoring system.



Warning: Every hole in the Backup and Monorail must be anchored using an approved adhesive (p. 16).

B) Tension Strut Backup Assembly (Figure 19)

Locate Tension Strut Backup and Monorail on foundation with side of Monorail on the construction line (Figure 20 on p. 27). **Verify that any applicable Transition Panels fit properly before anchoring Backup.** Drill 7/8" [22 mm] diameter by 5 3/4" [145 mm] deep anchor boreholes in foundation using the Backup as template. Anchor the Backup to the concrete foundation using an approved adhesive supplied with the QuadGuard II (p. 16).

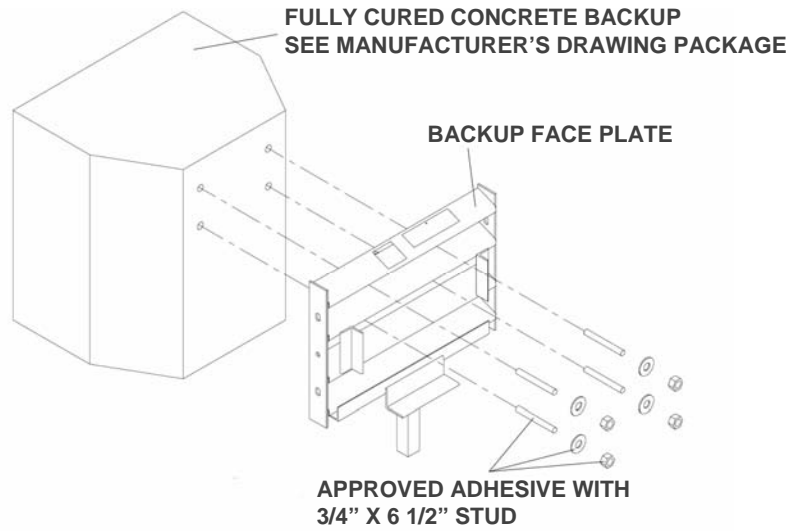


Figure 18
Anchoring Backup Face Plate to
Concrete Backup

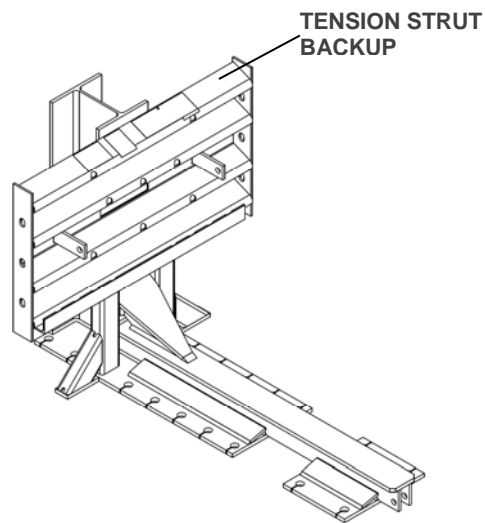


Figure 19
Anchoring Tension Strut Backup
to Foundation

3) Anchor the Monorail

A) Monorail Placement for Concrete Backup (Figure 20)

Locate Monorail on foundation with side of Monorail on the construction line and rear edge of Monorail foot 10" forward of front face of Concrete Backup (Figure 20).

Orient the Monorail so that the Monorail tongues face Backup (Figure 20).

Drill 7/8" [22 mm] diameter by 5 3/4" [145 mm] deep boreholes using the Monorail as a template. Do not drill through foundation.



Warning: Improper alignment at the Monorail Sections will prevent proper system collapse during impact (Figure 23).

Anchor each Monorail section using an approved Trinity Highway adhesive kit. See Figure 20 and the approved adhesive instructions included with the adhesive kit. It is important to attach each segment of Monorail in alignment from the back to the front of the system ($\pm 1/4"$ [6 mm]).



Warning: Every borehole and slot in Backup and Monorail must be anchored by a stud using an approved adhesive.

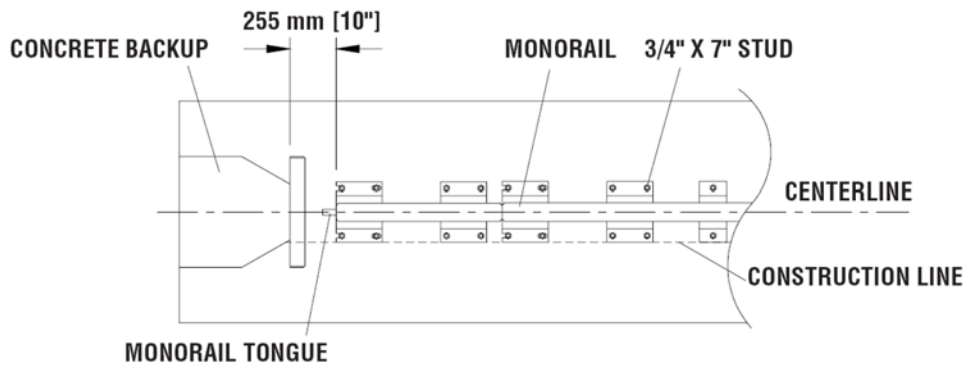


Figure 20
Monorail Placement for Concrete Backup

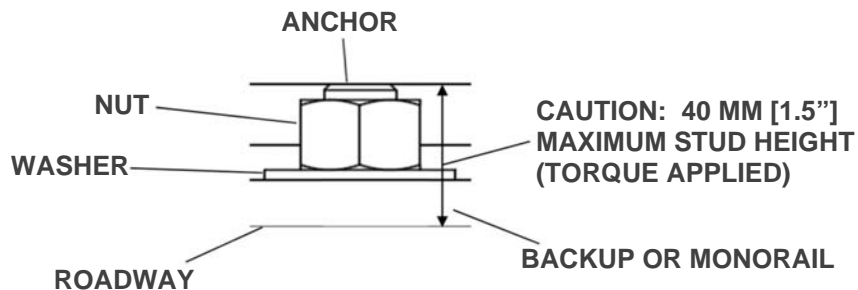


Figure 21
Proper Stud Height
(Torque Applied)

B) Monorail Placement for Tension Strut Backup (Figure 22)

Locate Monorail on foundation with side of Monorail on the construction line and rear edge of Backup foot 4" forward of edge of foundation (Figure 22).

Orient the Monorail so that the Monorail tongues face the Backup (Figure 23).

Drill 7/8" [22 mm] diameter by 5 3/4" [145 mm] deep boreholes using the Monorail as a template. Do not drill through foundation.



Warning: Every borehole and slot in Backup and Monorail must be anchored by a stud using a Trinity Highway approved adhesive.

Anchor each Monorail section using the Trinity Highway approved adhesive kits provided. See Figure 21 and the approved adhesive instructions included with each kit. It is important to attach each segment of Monorail in alignment from the back to the front of the system ($\pm 1/4"$ [6 mm]).



Warning: Improper alignment at the Monorail splice joints will prevent proper system collapse during an impact (Figure 23).

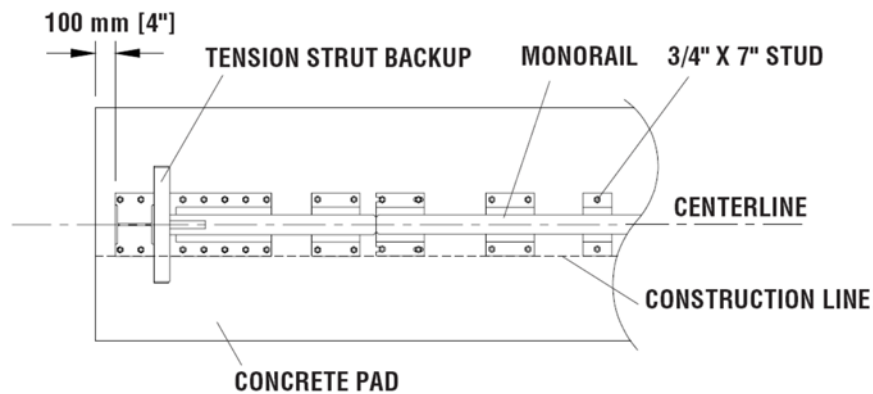


Figure 22
Backup and Monorail Placement for Tension Strut Backup

It is important to align each segment of Monorail from the back to the front of the system ($\pm 1/4"$ [6 mm]). Anchor each Monorail section using the provided Trinity Highway approved adhesive kit.

Drill 7/8" [22 mm] diameter by 5 3/4" [145 mm] deep boreholes using the Monorail as a template. Do not drill through foundation.

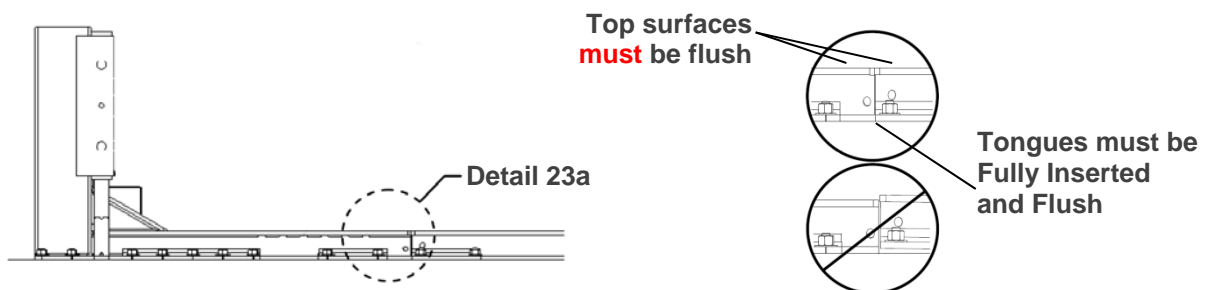


Figure 23
Rail Height and Alignment

Detail 23a

4) Attach Side Panels and/or Transition Panels to Backup Assembly

Attach Transition Panel or Side Panel to side of Backup using 5/8" X 2" rail bolt and 5/8" rail nut (two places - top and bottom holes only). See Backup Assembly drawing(s) **below**.

Note: A Side Panel is not needed when a Transition Panel is used.

Assembly tip:

Use drift pin to align the center hole of the Panel with the center hole of the Backup before inserting the rail bolts.

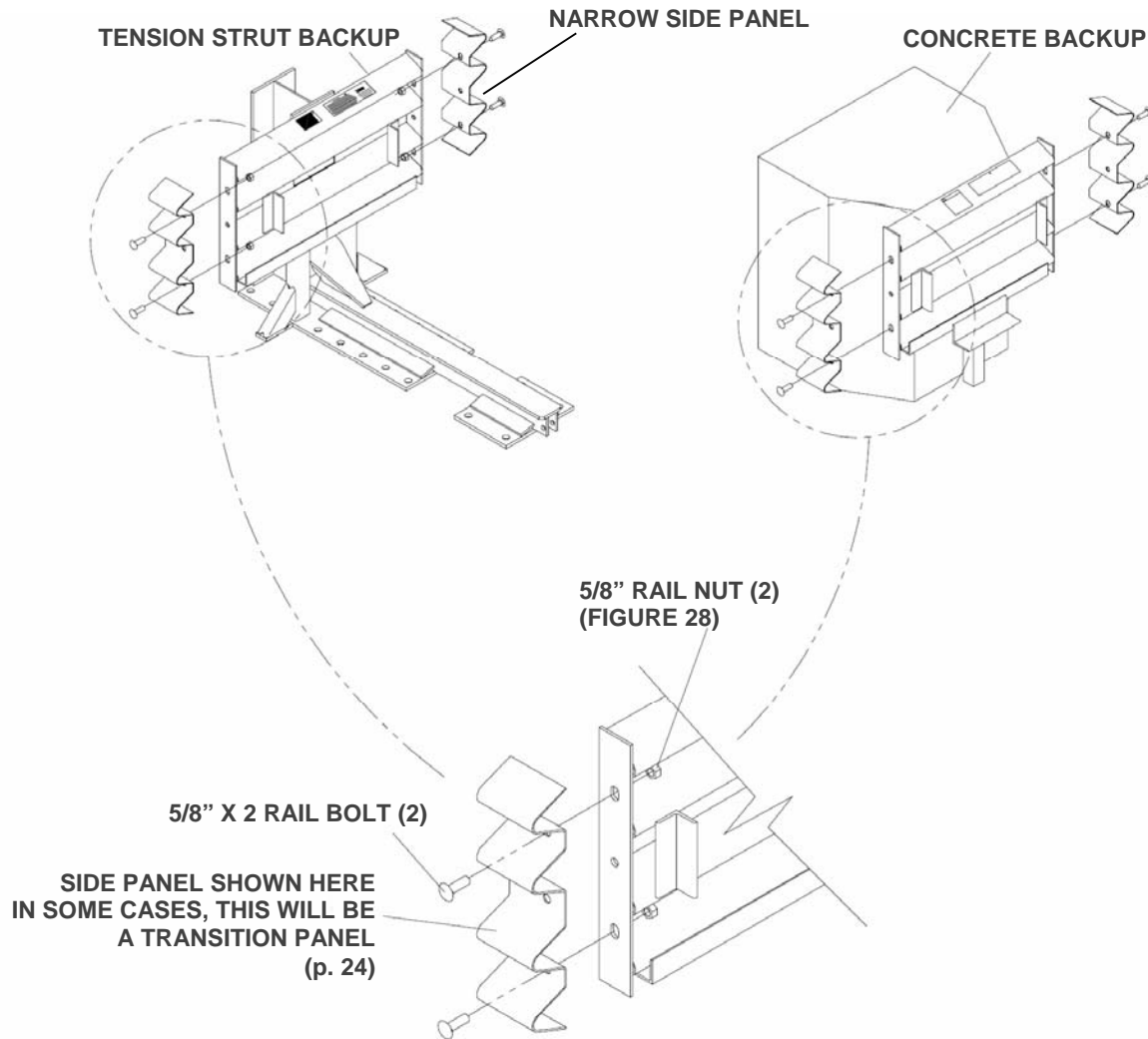


Figure 24
Side Panel/Transition Panel Attachment

5) Attach Monorail Guides

Attach Monorail guides to Diaphragm as follows:

Insert 3/4" x 2" G8 hex bolt through Monorail guide and Diaphragm, oriented as shown in Figure 25. Secure with 3/4" lock washer and 3/4" hex nut (typical 4 places). See also Diaphragm Assembly drawing. Shims are sandwiched between the Rail Guide and Diaphragm.

Repeat process for each Diaphragm.

6) Attach Diaphragms

Orient a Diaphragm so that the front face of the Diaphragm shape faces toward the Nose of the system as shown in Figure 26.



Important: Slide one Diaphragm all the way to the Backup to ensure the system is able to collapse properly during impact. Once this has been verified, slide the Diaphragm to approximately 36" [915 mm] in front of the Backup

Orient and slide all other Diaphragms onto Monorail and position each approximately as shown in Figure 27.

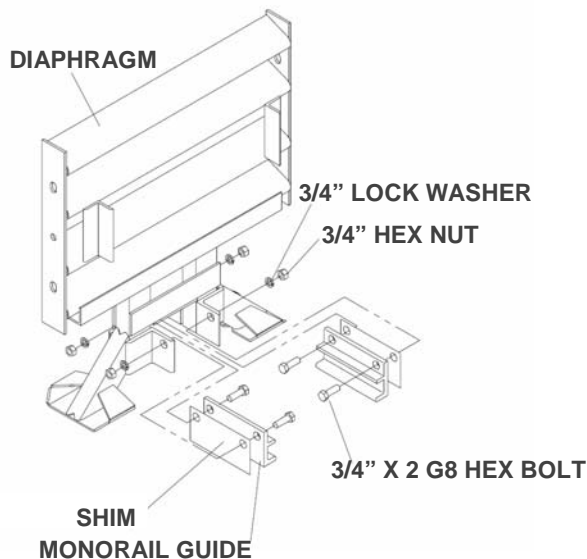


Figure 25
Monorail Guide Attachment

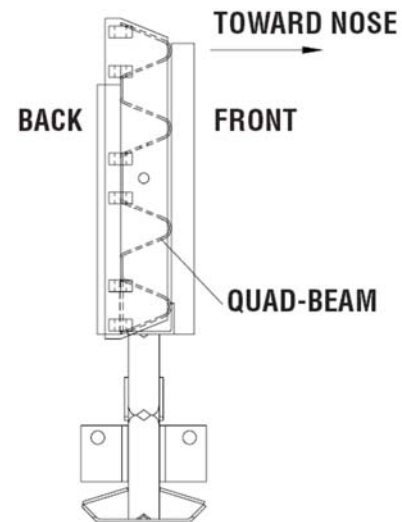


Figure 26
Diaphragm Orientation

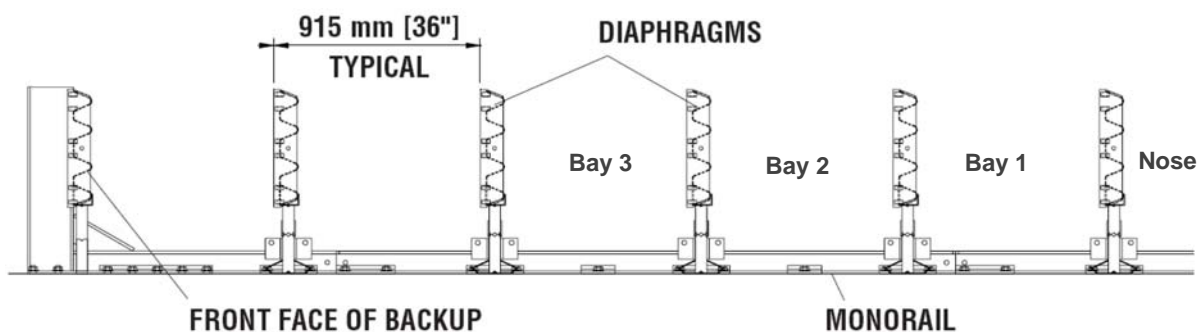


Figure 27
Diaphragm Spacing

7) Attach Fender Panels



Important: Do not mix the 5/8" rail nuts (large) with the 5/8" hex nuts (small) (Figure 28).

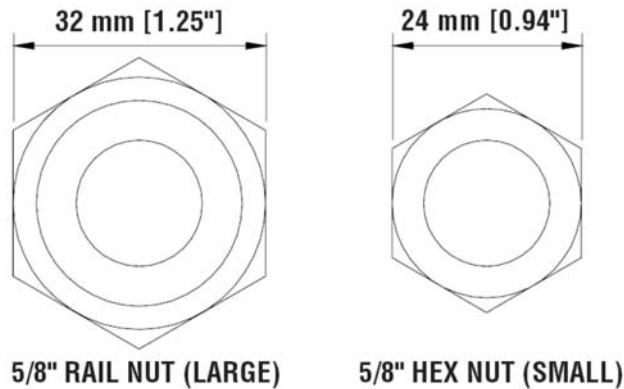


Figure 28
Rail Nuts are Oversize

Starting at the Backup, attach left and right Fender Panels shown on page 32 and Fender Panel Assembly drawing.

Step 1

Place the Fender Panel so that the center of the slot of the rearward Diaphragm is lined up with the approximate center of the slot in the Fender Panel.

Install the Mushroom Washer Assembly as shown in Figure 29 and Detail 29a and Detail 29b, but do not torque at this time. This (Step 1) helps to balance the Fender Panel.

Step 2

Slide the Fender Panel forward until the holes in the Fender Panel line up with the holes in the forward Diaphragm.

Step 3

Use a drift pin to align the center hole of the Fender Panel with the center hole of the Diaphragm.

Step 4

Attach the front of the Fender Panels to the next Diaphragm using two (2) rail bolts and large rail nuts per side. Use only the top and bottom holes; leave the center hole open until the next Fender Panel is attached.

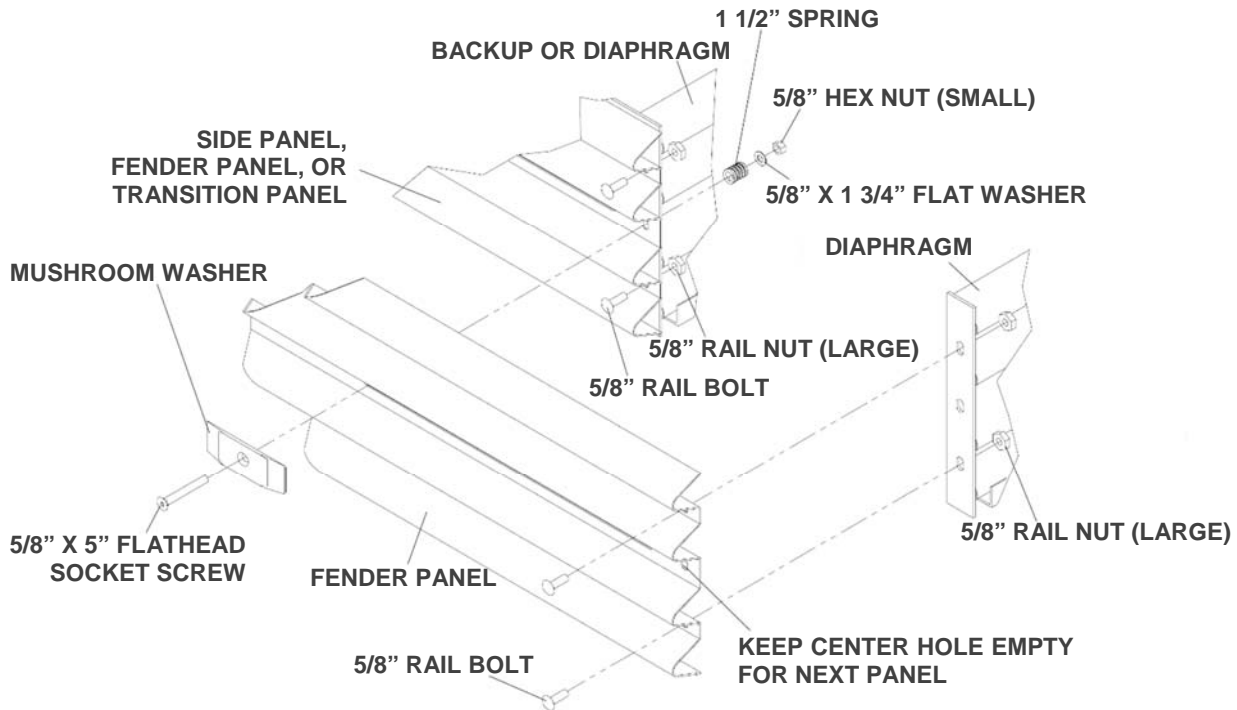
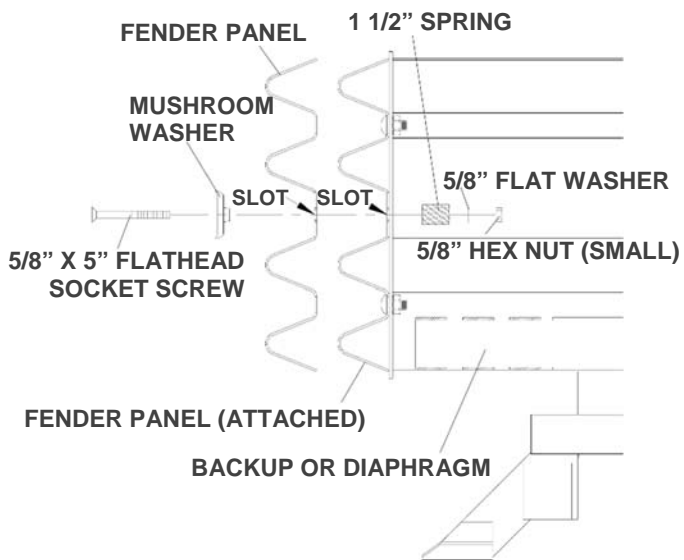


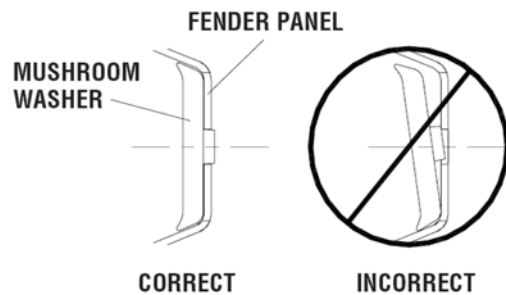
Figure 29
Fender Panel Assembly

Step 5

Ensure Mushroom Washer lays flat against the Fender Panel as shown in Figure 29b. Standoff on Mushroom Washer must be seated completely through slot.



Detail 29a
Mushroom Washer Attachment



Detail 29b
Mushroom Washer Orientation

Step 6

Check Diaphragm spacing to ensure 36" [915 mm] between rear faces of consecutive Diaphragms, as shown in Figure 30 and Fender Panel Assembly drawing.

Step 7

Once proper spacing has been achieved, tighten the Mushroom Washer Assembly (small hex) nut until it reaches the end of the threads. Tighten rail nut (large hex) at the front of the Fender Panels. Ensure rail bolt shoulder is seated within the Fender Panel slot.

Assemble the remaining Diaphragms and Fender Panels following the same procedures.

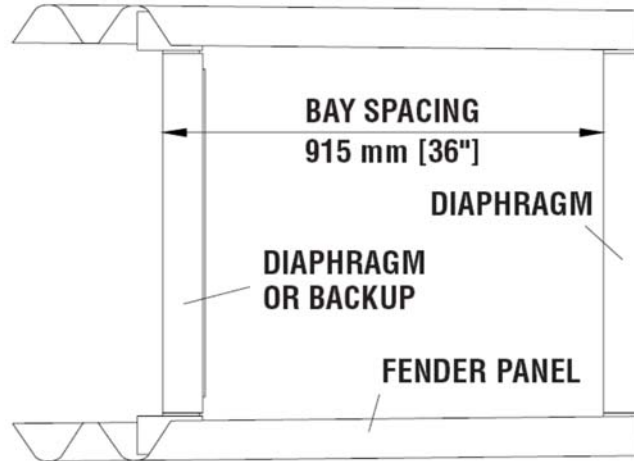


Figure 30
Proper Diaphragm Spacing

8) Attach End Cap (Figure 31)

Using a 5/8" x 3 1/2" G5 hex bolt, 5/8" hex nut, and 5/8" lock washer, attach the End Cap to the front of the first Monorail segment.

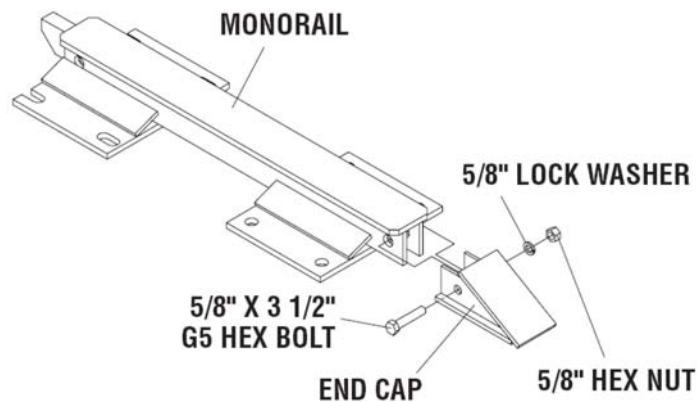


Figure 31
Monorail End Cap Assembly

9) Attach Cartridge Support Brackets (Figure 32)

Attach lower Cartridge Support Bracket to front and back of all Diaphragms and front of Backup, as shown in Figures 32 to 35 and Backup Assembly drawings.

Note: 24" [610 mm] wide systems do not have Side Cartridge Support Brackets: 30" [760 mm], 36" [915 mm] and 48" [1219 mm] wide systems have Side Cartridge Support Brackets welded to the Backup and Diaphragms.

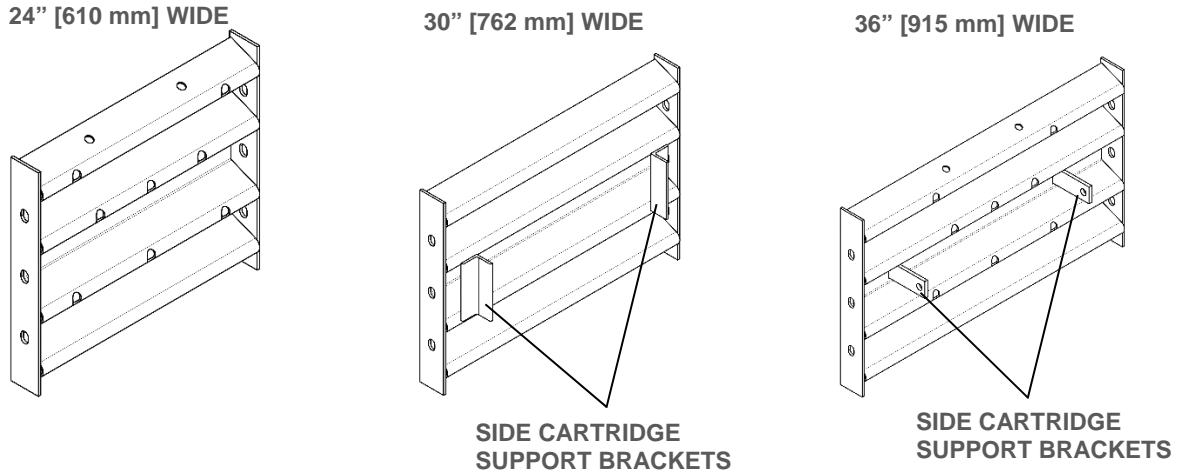


Figure 32
Side Cartridge Support Brackets

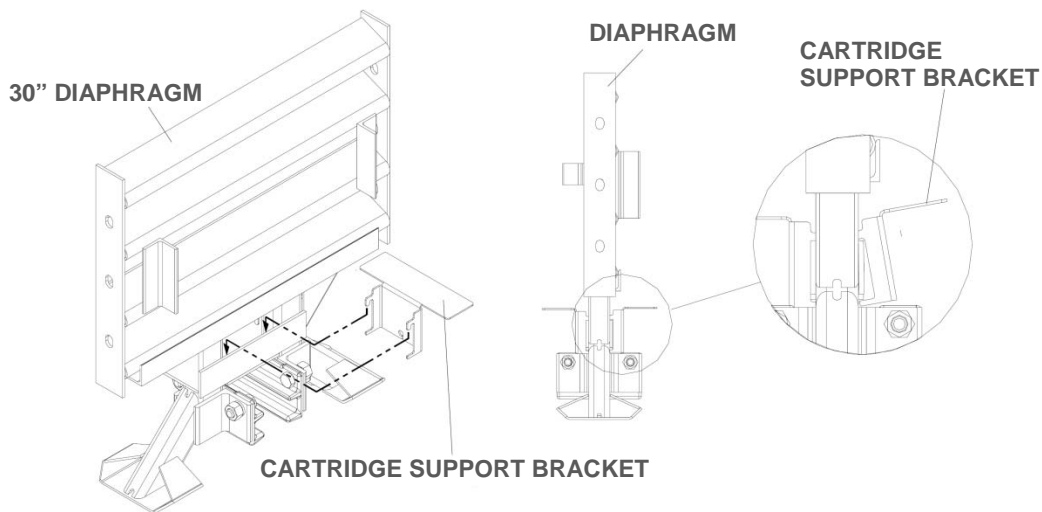


Figure 33
Lower Cartridge Support Bracket Assembly

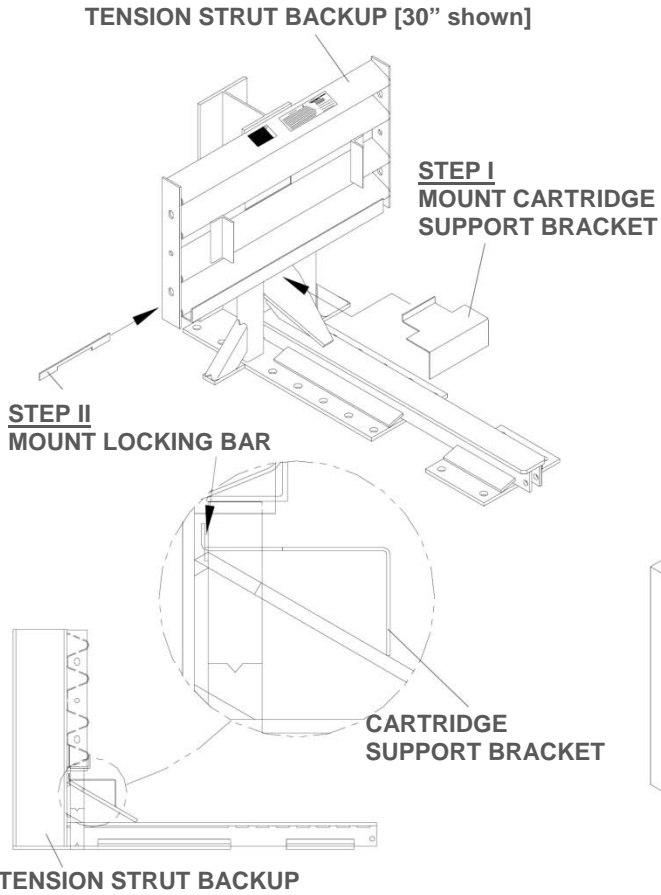


Figure 34
Lower Cartridge Support Bracket Assembly
(Tension Strut Backup)

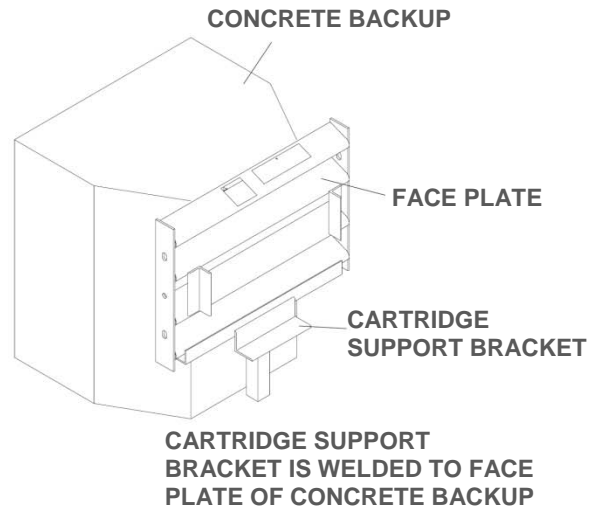


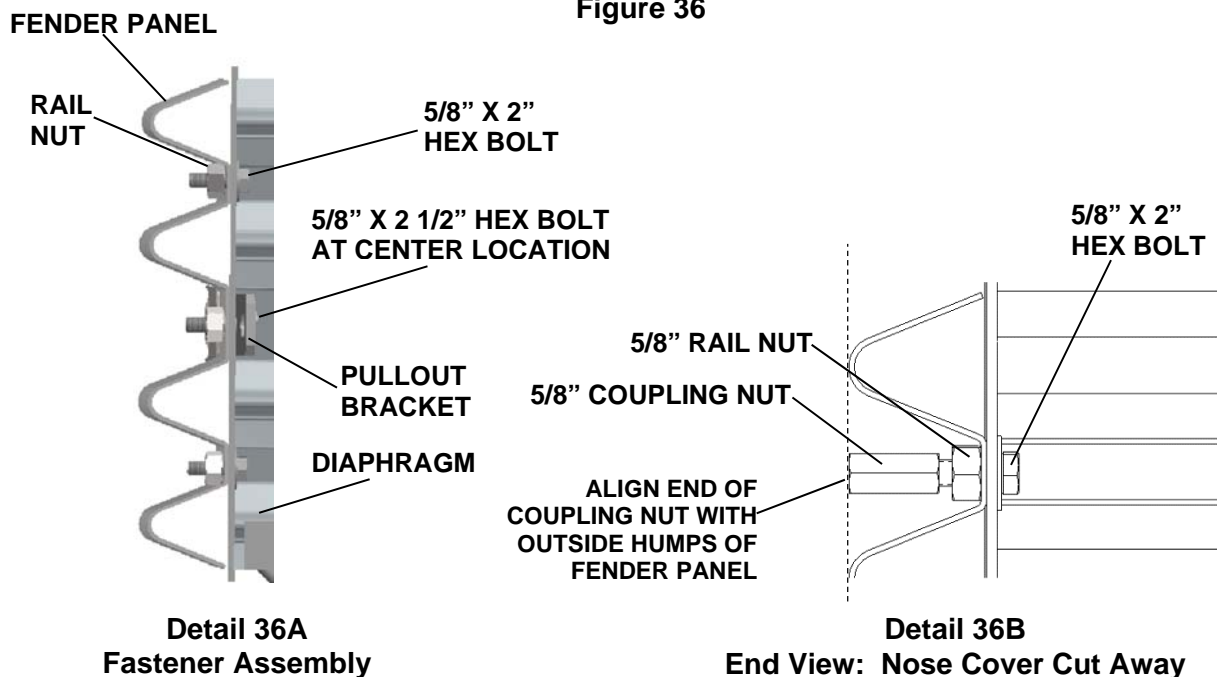
Figure 35
Lower Cartridge Support Bracket
(Concrete Backup)

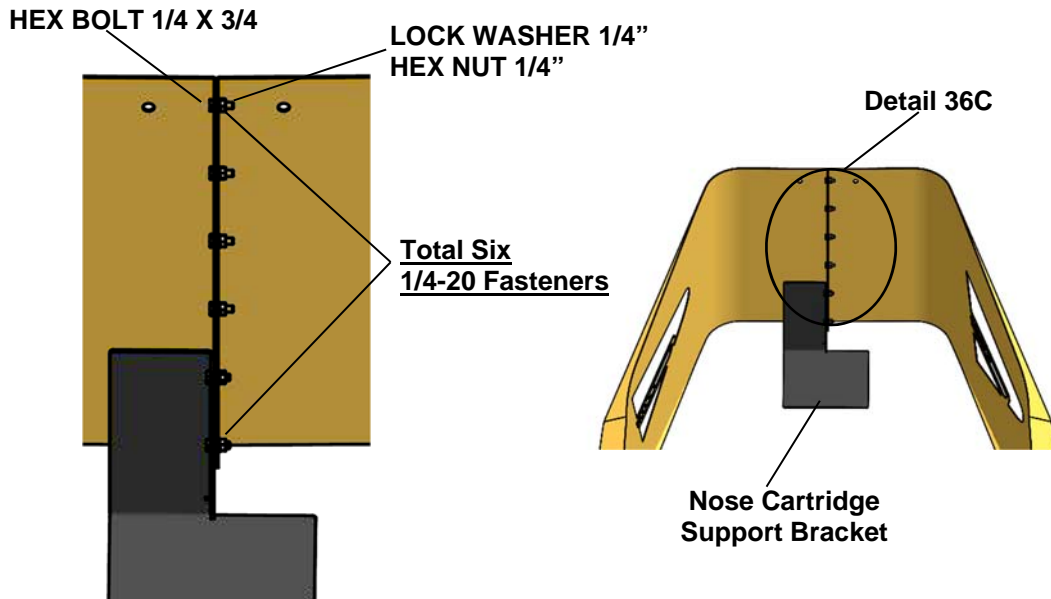
10) Attach Steel Nose Assembly

- A) Install two (2) 5/8" X 2" hex bolts and one (1) 5/8 X 2 1/2" hex bolt with Pullout Bracket through Diaphragm side plate. Fasten all three (6 total) bolts with 5/8" rail nuts on each side and tighten (Detail 36A).
- B) Thread 5/8" coupling nuts on 5/8" hex bolts to align with outside of Fender Panel (Detail 36B).
- C) Join Steel Nose halves using 1/4" X 3/4" hex bolts, lock washers and nuts. Include Cartridge Support Nose Bracket in lower two fastener sets (Detail C & D).
- D) Attach Steel Nose to Diaphragm using 5/8" X 1 1/4" hex socket bolt and 5/8" x 1 1/4" flat washer (Detail 69E). Steel Nose top edge should be 32 1/8" above concrete surface.
- E) Place the Cartridge Support Bracket on the front of the first Diaphragm (Detail 36F). Place a Type I Cartridge in the Nose Bay.



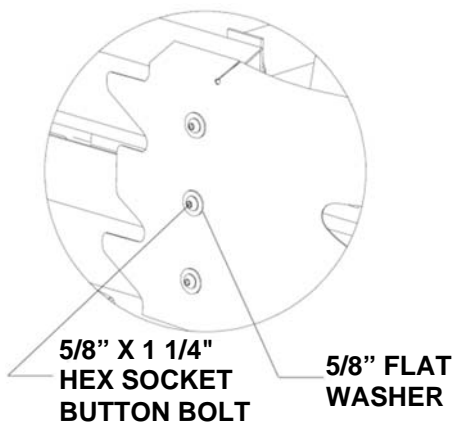
Figure 36



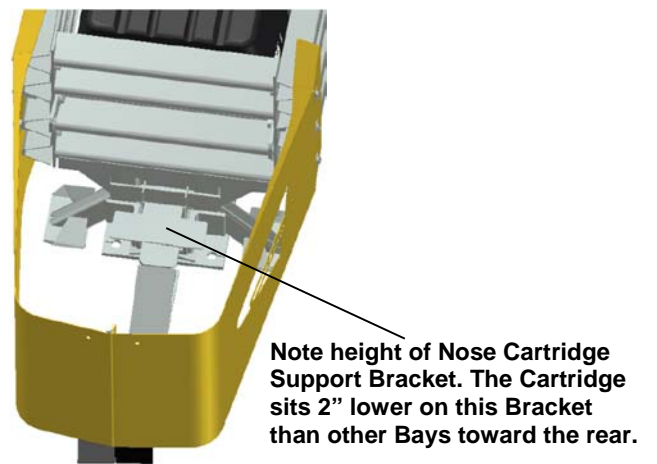


Detail 36C

Detail 36D



Detail 36E



Detail 36F

Detail 36D shows proper placement of front Cartridge Support Bracket.

11) Checking the System Assembly

Recheck to ensure that all fasteners are properly tightened throughout the system (anchor bolts, etc.). See torque requirements below. Check all Fender Panels. If they do not fit tightly against the underlying Fender Panel, system realignment may be necessary (Figure 37). Verify the top of the Steel Nose is 32 1/8" above the roadway (p. 36).



Warning: Ensure that the QuadGuard® II and delineation used meet all federal, state, specifying agency, and local specifications.



Warning: Ensure delineation on the assembly meets all appropriate MUTCD and local standards.



Warning:	
Anchor Requirements	
Anchor Studs – Anchoring Information Table, p. 16 May slightly protrude above nuts	
Critical Clearances	
Anchor Studs above nuts – Figure 21, p. 27 Fender Panel Gap Narrow – 7/8" [22 mm] see below	

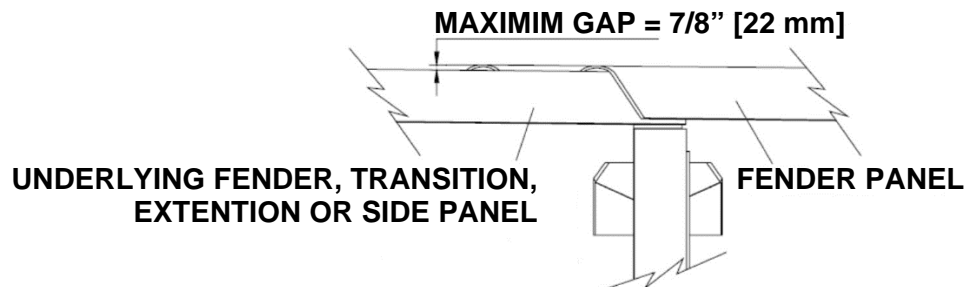


Figure 37
Fender Panel Gap for Narrow Systems

13) Cartridge Placement

Be sure the Adjustable Cartridge Support in the Nose is attached correctly (p. 37). The top surface of the Nose Cartridge should be horizontal.

To complete the assembly of a QuadGuard® II, place the appropriate Cartridge in each Bay and Nose section of the system. Type 1 Cartridges are placed toward the front (Nose) of the system; Type 2 Cartridges are placed toward the rear (Backup) of the system (Figures 38 and 39). Ensure all Cartridges are pointed toward the front of the system per Cartridge direction arrow(s).



Warning: Placing the wrong Cartridge in the Nose or any Bay will result in system performance that has not been crash tested pursuant to the NCHRP Report 350 criteria.

I - TYPE I CARTRIDGE
II - TYPE II CARTRIDGE

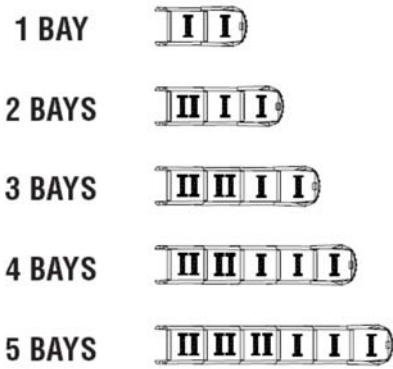


Figure 38
Cartridge Placement

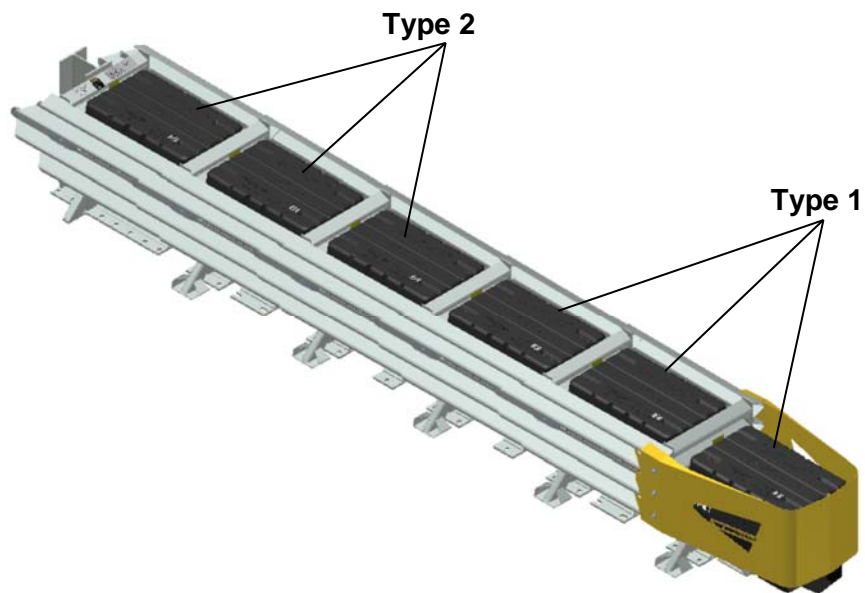
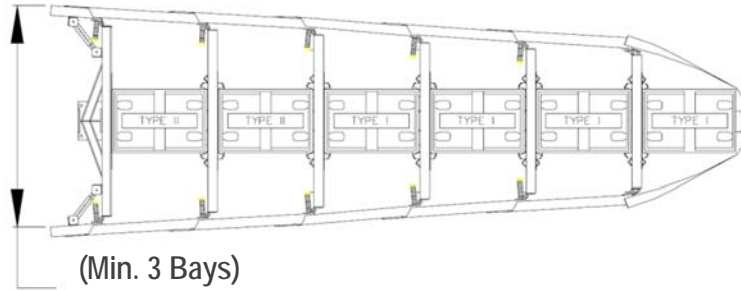
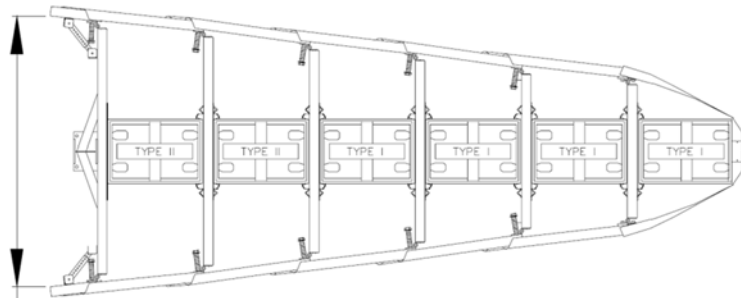


Figure 39
Five Bay System

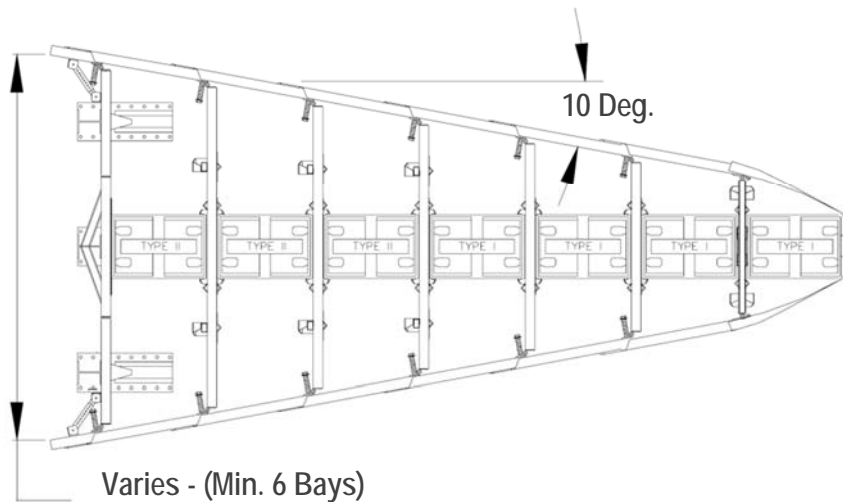
Wide (Flared) Systems



(Min. 3 Bays)
1755 mm [69"] Model No. QG2 __ 69



(Min. 3 Bays)
2285 mm [90"] Model No. QG2 __ 90



Varies - (Min. 6 Bays)
3200 mm [126"] Model No. QG2 __ 126

Figure 40
Wide System(s) and Model Numbers

Assemble Wide (Flared)



Important: The Manufacturer's Drawing Package supplied with the QuadGuard® II must be used with these instructions for proper assembly and should take precedence over these general instructions.

Determine Backup and Transition Type

The QuadGuard® II is available with a Tension Strut Backup or a Concrete Backup. See Figures 41 and 42, along with the Backup assembly drawing, to determine which type of Backup is being deployed.

A Transition Panel or Side Panel must be used on each side of the Backup. A Side Panel is not needed when a Transition Panel is used. Several types of transitions are available for use with the QuadGuard® II. See Figures 44 through 48 and the Manufacturer's Drawing Package to determine which types of Fender Panels to attach.

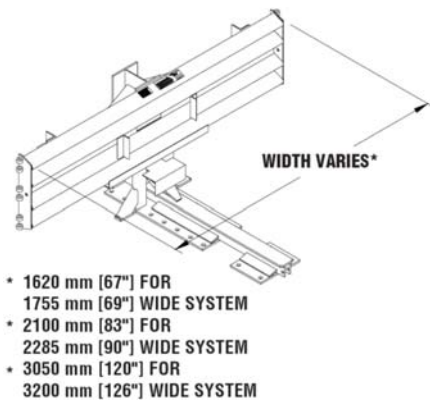


Figure 41
Tension Strut Backup

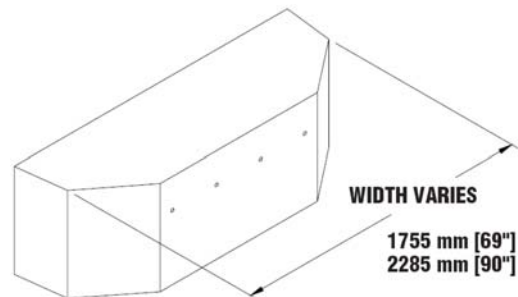


Figure 42
Concrete Backup

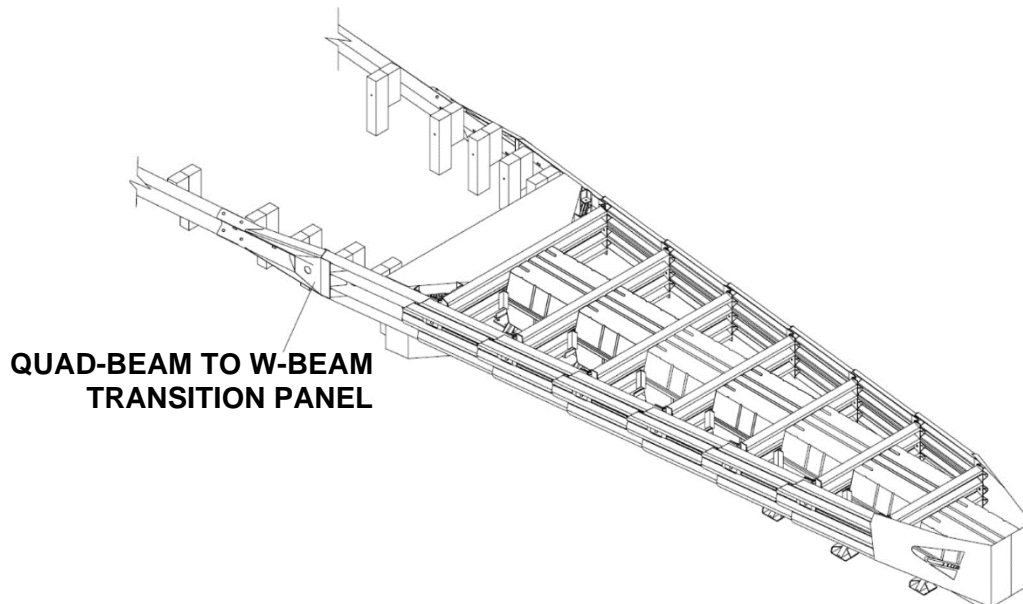


Figure 43
QuadGuard® II Transitioning



Important: The proper Transition Panel or Side Panel must be used to perform as crash tested. **The correct Panel(s) to use will depend on the direction of traffic and what type of barrier or roadside obstacle the QuadGuard® II is shielding.** Contact Customer Service prior to deployment if you have any questions (p. 3).

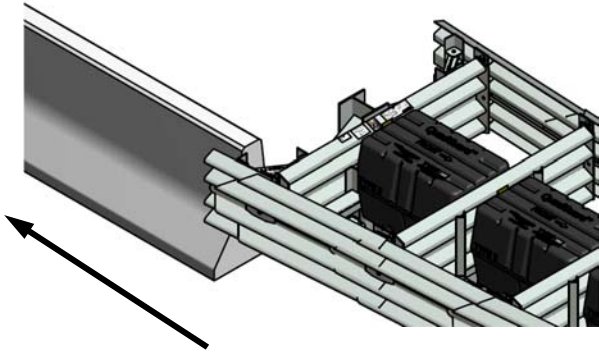


Figure 44
No Transition

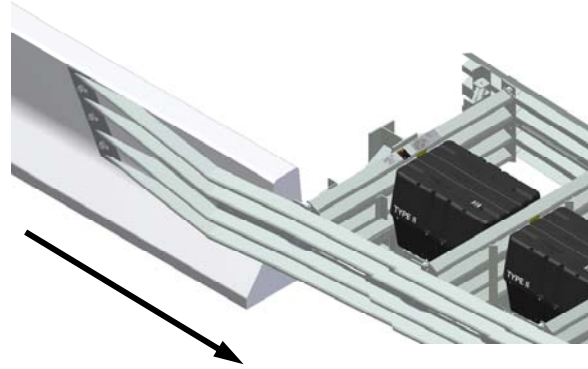


Figure 45
Quad-Beam to Safety Shape Barrier

Note: Arrows indicate traffic direction.

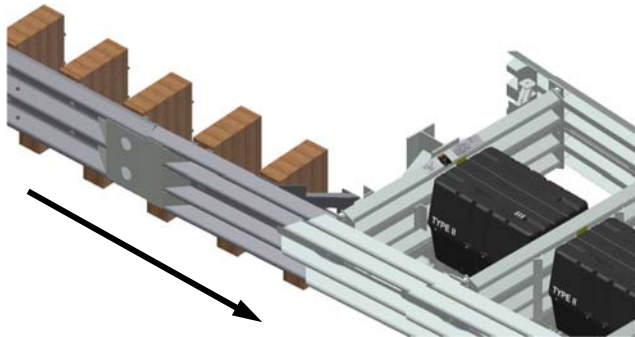


Figure 46
Quad-Beam to Thrie-Beam

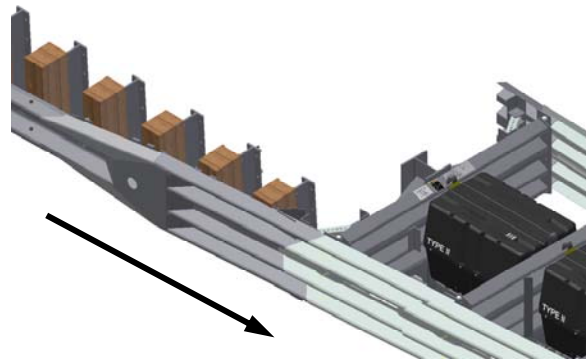
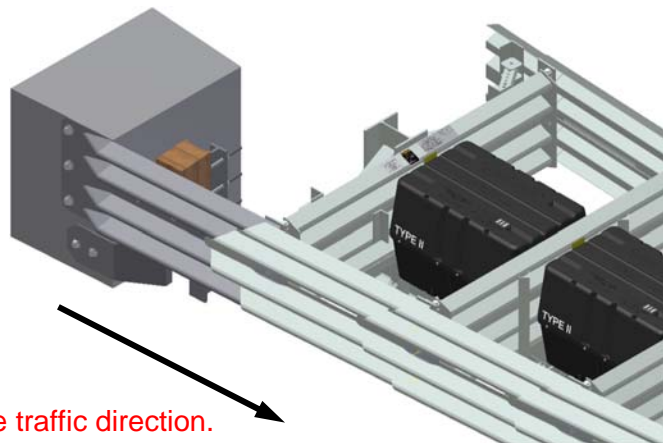


Figure 47
Quad-Beam to W-Beam



Note: Arrows indicate traffic direction.

Figure 48
Quad-Beam End Shoe

1) Mark System Location

Locate the centerline of the system by measuring the proper offset from the roadside obstacle. See the Manufacturer's Drawing Package supplied with the system. Place chalk line to mark the centerline of the system. Mark a construction line parallel to the center line and offset 6.5" [165 mm] to one side as shown in Figure 49. The edge of the Monorail will be placed on this line.

Note: The concrete foundation shall comply with the Manufacturer's Drawing Package supplied with the system.



Warning: Location of system with respect to the roadside object is critical and dependent on the type of Transition Panel used. See the Manufacturer's Drawing Package supplied with the system for details.



Figure 49
(Top view of concrete foundation)

2) Anchor the Backup

A) Concrete Backup Construction (Figure 50)

Locate Backup Face Plate using the Backup assembly drawing. **Verify that any applicable Transition Panels fit properly before anchoring the Face Plate.** Drill anchor boreholes in the Concrete Backup using the Face Plate as a template. Anchor the Face Plate to the Concrete Backup using an approved adhesive supplied with the QuadGuard® II (p. 16).

A **Trinity Highway approved adhesive anchoring system is required** to securely anchor crash cushions and other common highway devices. Trinity Highway approved adhesive features high pullout strength, vibration resistance, and durability. Each approved adhesive kit contains adhesive, studs, nuts and washers. Both vertical and horizontal assemblies require an approved adhesive anchoring system.



Warning: Every borehole and slot in Backup and Monorail must be anchored by a stud using an approved adhesive.

B) Tension Strut Backup Assembly (Figure 51)

Locate the Tension Strut Backup and Monorail on foundation with side of Monorail on the construction line (p. 47). **Verify that any applicable Transition Panels fit properly before anchoring Backup.** Drill 7/8" [22 mm] diameter by 5 3/4" [145 mm] deep anchor boreholes in foundation using the Backup as template. Anchor the Backup to the concrete foundation using the Trinity Highway approved adhesive supplied with the QuadGuard® II (p. 16).

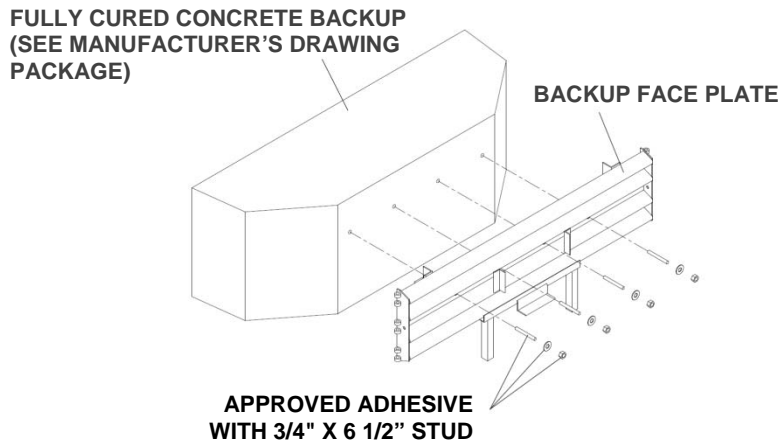


Figure 50
Anchoring Backup Face Plate to Concrete Backup

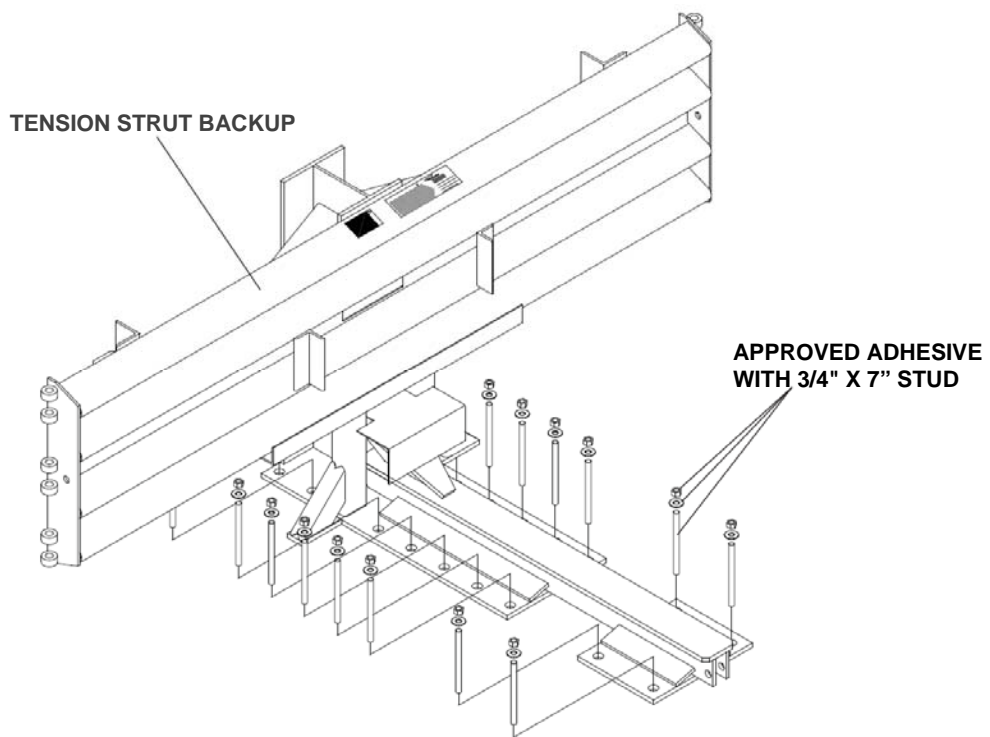


Figure 51
Anchoring Tension Strut Backup to Foundation

C) Extra-Wide Tension Strut Backup Assembly (Figure 52)

Locate the Extra-Wide Tension Strut Backup **center** section and Monorail on foundation with side of Monorail on the construction line.

Locate the Extra-Wide Tension Strut Backup **left** section on the left side of the center section, aligning the three holes in the side plates.

Locate the Extra-Wide Tension Strut Backup **right** section on the right side of the center section, aligning the three holes in the side plates.

Secure the Backup sections to each other using 5/8" x 2" hex bolt, 5/8" x 1 3/4" flat washer (2), 5/8" lock washer and 5/8" hex nut (6 places) as shown in Figure 52 and Detail 52a.

Verify that any applicable Transition Panels fit properly before anchoring Backup. Drill anchor boreholes in foundation using the Backup as template. Anchor the Backup to the foundation using Trinity Highway approved adhesive kits supplied with the QuadGuard® II (p. 16).



Warning: Every borehole and slot in Backup and Monorail must be anchored by a stud using a Trinity Highway approved adhesive.

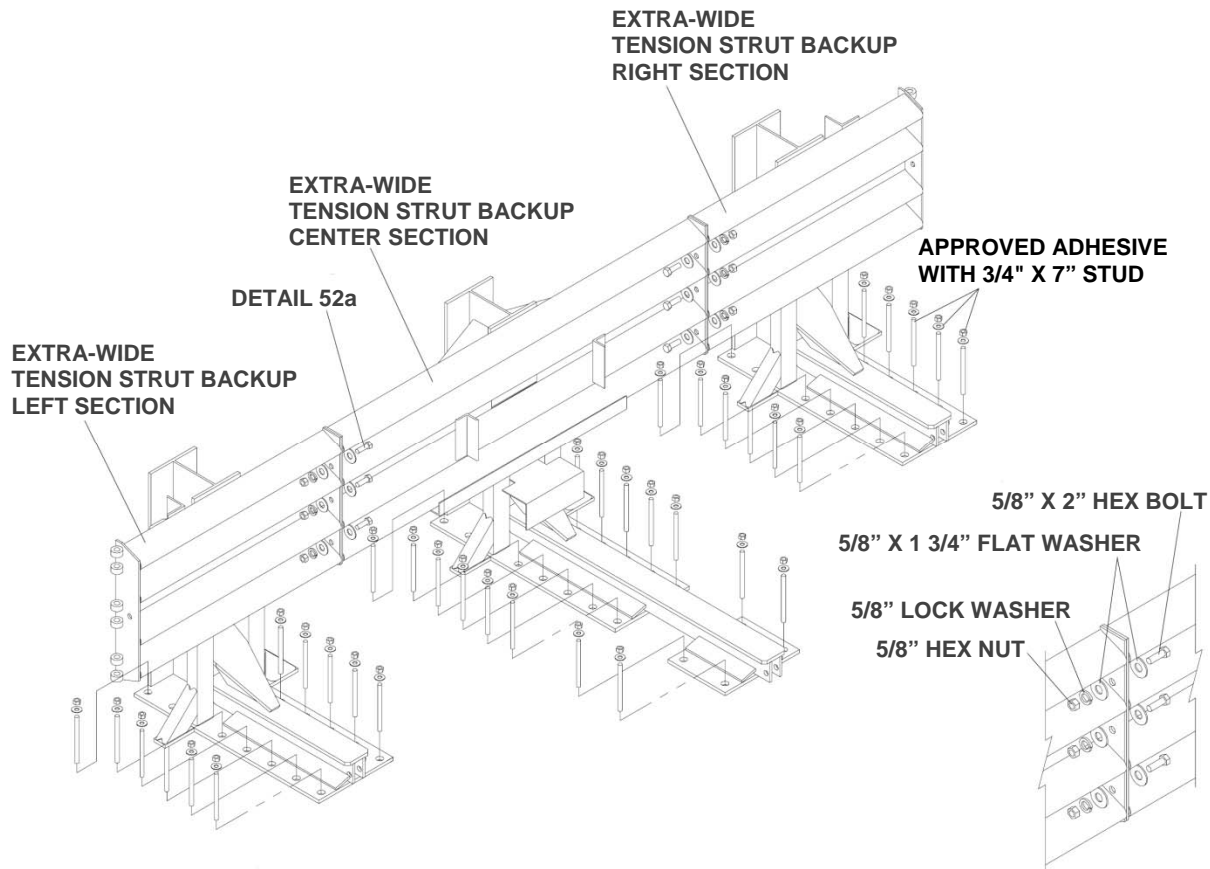


Figure 52
Anchoring Extra-Wide Tension Strut Backup to Foundation

Detail 52a

3) Anchor the Monorail

A) Monorail Placement for Concrete Backup (Figure 53)

Locate Monorail on foundation with side of Monorail on the construction line and rear edge of Monorail 10" forward of front face of Concrete Backup. Orient the Monorail so that the Monorail tongues face Backup (Figure 53).

Drill 7/8" [22 mm] diameter by 5 3/4" [145 mm] deep boreholes using the Monorail as a template. Do not drill through foundation.



Warning: Improper alignment at the Monorail Splice Joints may prevent proper system collapse during impact (Figure 56).

Anchor each Monorail section using an approved adhesive kit (p. 16). It is important to attach each segment of Monorail in alignment from the back to the front of the system ($\pm 1/4"$ [6 mm]).



Warning: Every borehole and slot in Backup and Monorail must be anchored by a stud using an approved adhesive.

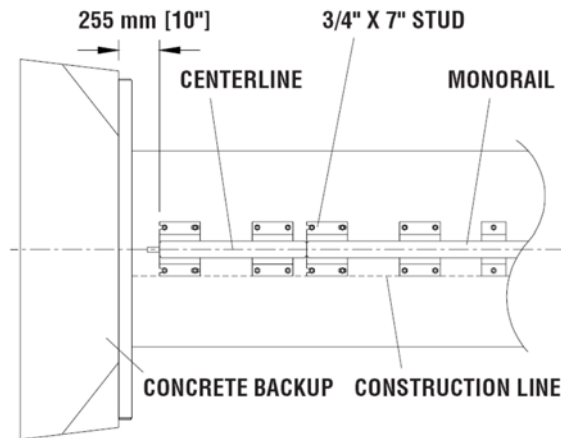


Figure 53
Monorail Placement for Concrete Backup

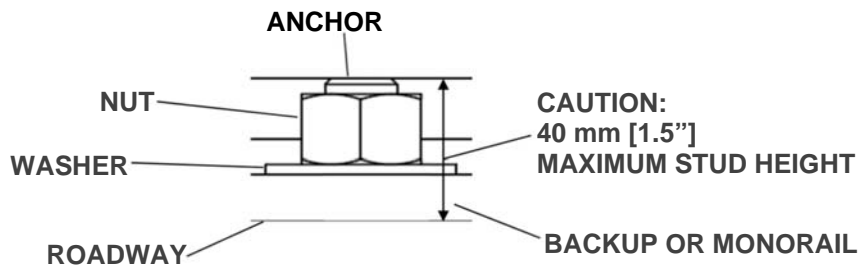


Figure 54
Proper Stud Height

Monorail Placement for Tension Strut Backup (Figure 55)

Locate Monorail on foundation with side of Monorail on the construction line and rear edge of Backup 4" forward of edge of foundation. Orient the Monorail so that the Monorail tongues face the Backup (Figure 56 & Detail 56a).

Drill 7/8" [22 mm] diameter by 5 3/4" [145 mm] deep boreholes using the Monorail as a template. Do not drill through foundation.



Warning: Every borehole and slot in Backup and Monorail must be anchored by a stud using an approved adhesive.

Anchor each Monorail section using the Trinity Highway approved adhesive kits provided. See Figure 54 and the approved adhesive instructions included with each kit. It is important to attach each segment of Monorail in alignment from the back to the front of the system ($\pm 1/4"$ [6 mm]).



Warning: Improper alignment at the Monorail splice joints will prevent proper system collapse during an impact (Figure 56).

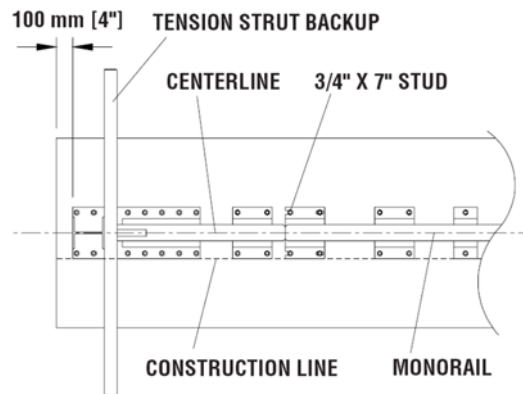


Figure 55
Backup and Monorail Placement for Tension Strut Backup

It is important to align each segment of Monorail from the back to the front of the system ($\pm 1/4"$ [6 mm]). Anchor each Monorail section using the provided Trinity Highway approved adhesive kit.

Drill 7/8" [22 mm] diameter by 5 3/4" [145 mm] deep boreholes using the Monorail as a template. Do not drill through foundation.

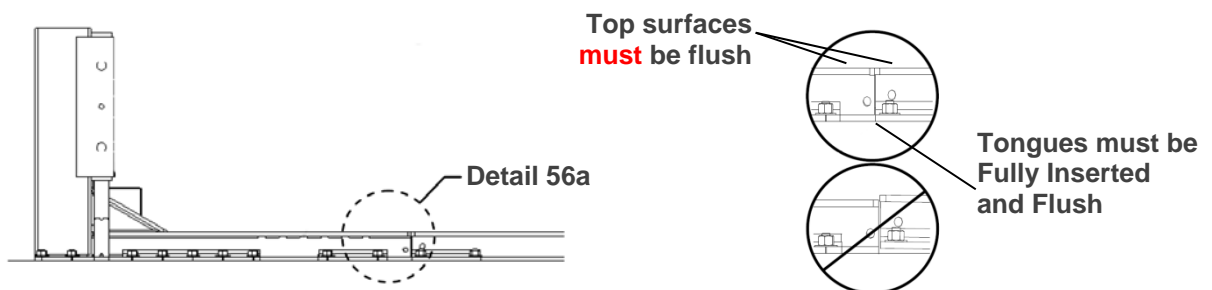


Figure 56
Rail Height and Alignment

Detail 56a

4) Attach Side Panels and/or Transition Panels to Backup Assembly (Figure 57)

- a. Attach Hinge Plate to the Transition Panel or Side Panel using 5/8" rail bolt and 5/8" rail nut (two places – top and bottom holes only).
- b. Attach Transition Panel or Side Panel assembly to Backup using 5/8" hex bolt, 5/8" lock washer and 5/8" hex nut (three places each side of Backup).
- c. Attach diagonal brace to Fender Panel and Backup using 3/8" hex bolt, 3/8" lock washer and 3/8" hex nut (two (2) places per brace: four (4) places per side).
- d. Secure each diagonal brace with a 3/8" hex bolt; 3/8" lock washer, and 3/8" hex nut (two (2) places per brace) as shown in Figure 57.

Note: A Side Panel is not needed when a Transition Panel is used. Diagonal braces are not used with some Transition Panels per the Manufacturer's Drawing Package.

Assembly tip:

Use drift pin to align the center hole of the Panel with the center hole of the Backup before attaching the rail bolts.

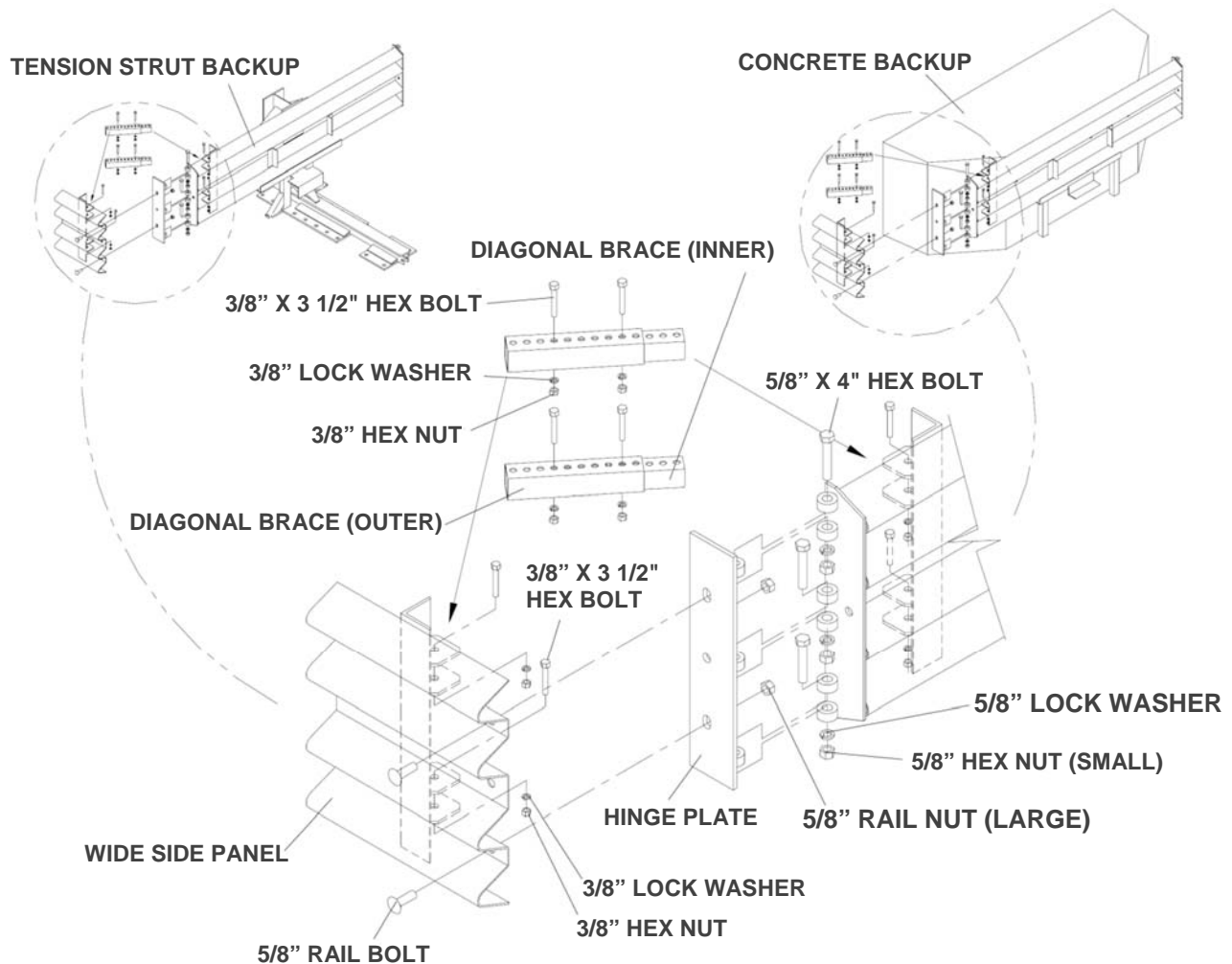


Figure 57
Side Panel/Transition Panel Attachment

5) Attach Monorail Guides

Attach Monorail guides to Diaphragm as follows:

Insert 3/4" x 2" G8 hex bolt through Monorail guide and Diaphragm (Figure 58). Check orientation and secure hex bolt with 3/4" lock washer and 3/4" hex nut (typical two places per guide). See also Diaphragm assembly drawing. Shims are sandwiched between Monorail guides and Diaphragm.

Repeat process for each Diaphragm.

6) Attach Diaphragms

Orient the widest Diaphragm so that the front face of the Diaphragm shape faces toward the Nose of the system as shown in Figure 59. **The widest Diaphragm must be attached closest to the Backup with each subsequent Diaphragm being progressively narrower.**



Important: Slide the widest Diaphragm onto the Monorail and all the way to the Backup to ensure system is able to collapse properly during impact. Once this has been verified, slide the Diaphragm forward to approximately 36" [915 mm] in front of the Backup.

Orient and slide all other Diaphragms onto Monorail and position each approximately as shown in Figure 60.

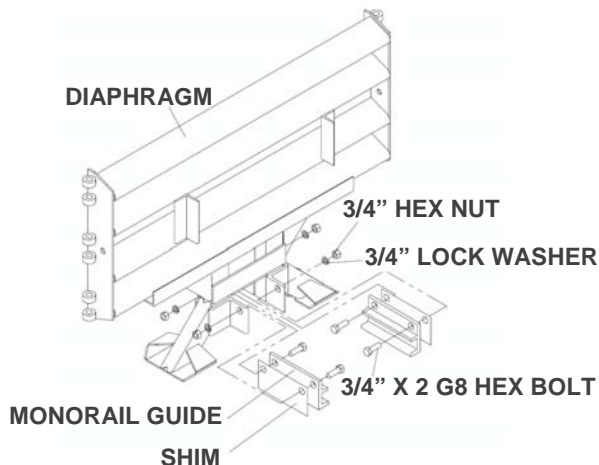


Figure 58
Monorail Guide Attachment

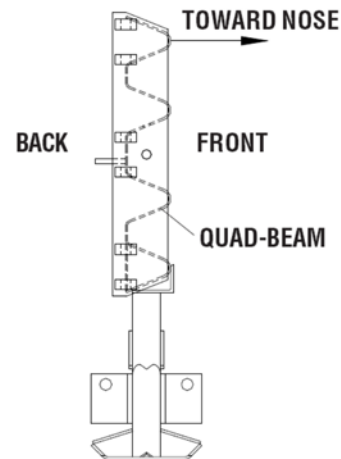


Figure 59
Diaphragm Orientation

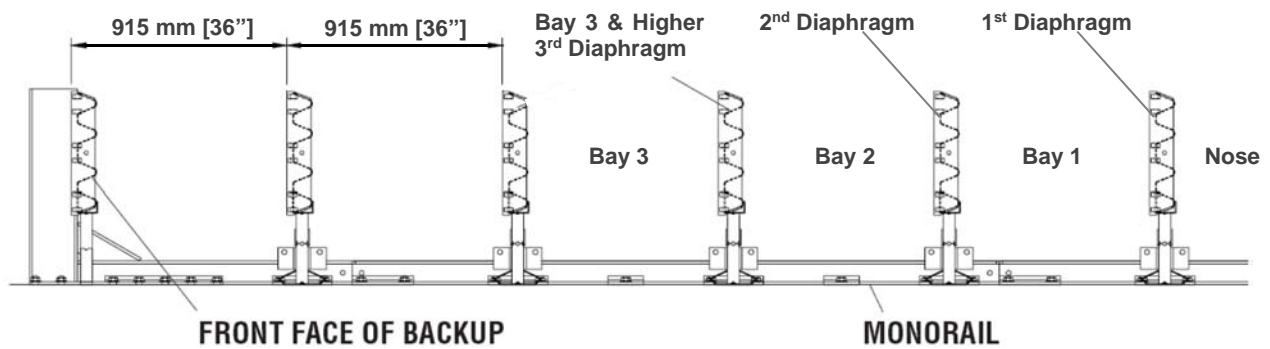


Figure 60
Diaphragm spacing

7) Attach Hinge Plate onto Fender Panels



Important: Do not mix the 5/8" rail nuts (large) with the 5/8" hex nuts (small).

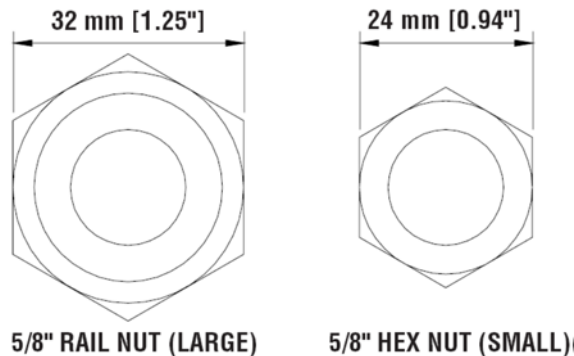


Figure 61
Rail Nuts are Oversize



Important: For proper impact performance, wide systems must use Hinge Plates.

Attach Hinge Plate on each Fender Panel using two (2) 5/8" rail bolts and two (2) 5/8" rail nuts, using top and bottom holes only, leaving the center-hole open as shown in Figure 62.

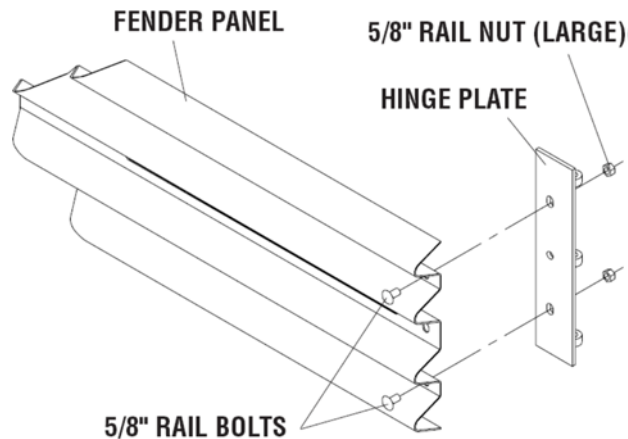


Figure 62
Hinge Plate Assembly

8) Attach Fender Panels

Starting at the Backup, attach left and right Fender Panels as shown in Figure 63.

Step 1

Place the Fender Panel so that the center of the slot of the rearward Diaphragm is lined up with the approximate center of the slot in the Fender Panel.

Install the Mushroom Washer Assembly as shown in Figure 63 and Detail 63A, but do not torque at this time (this will help to balance the Fender Panel).

Step 2

Slide the Fender Panel forward until the holes in the Fender Panel line up with the holes in the forward Diaphragm.

Step 3

Use a drift pin to align the center hole of the Fender Panel with the center hole of the Diaphragm.

Step 4

Attach the front of the Fender Panels to the next Diaphragm using two (2) rail bolts and large rail nuts per side. Use only the top and bottom holes; leave the center hole open until the next Fender Panel is attached.

Step 5

Be sure Mushroom Washer lays flat against the Fender Panel as shown in Figure 63B. Standoff on Mushroom Washer must be seated completely through slot.

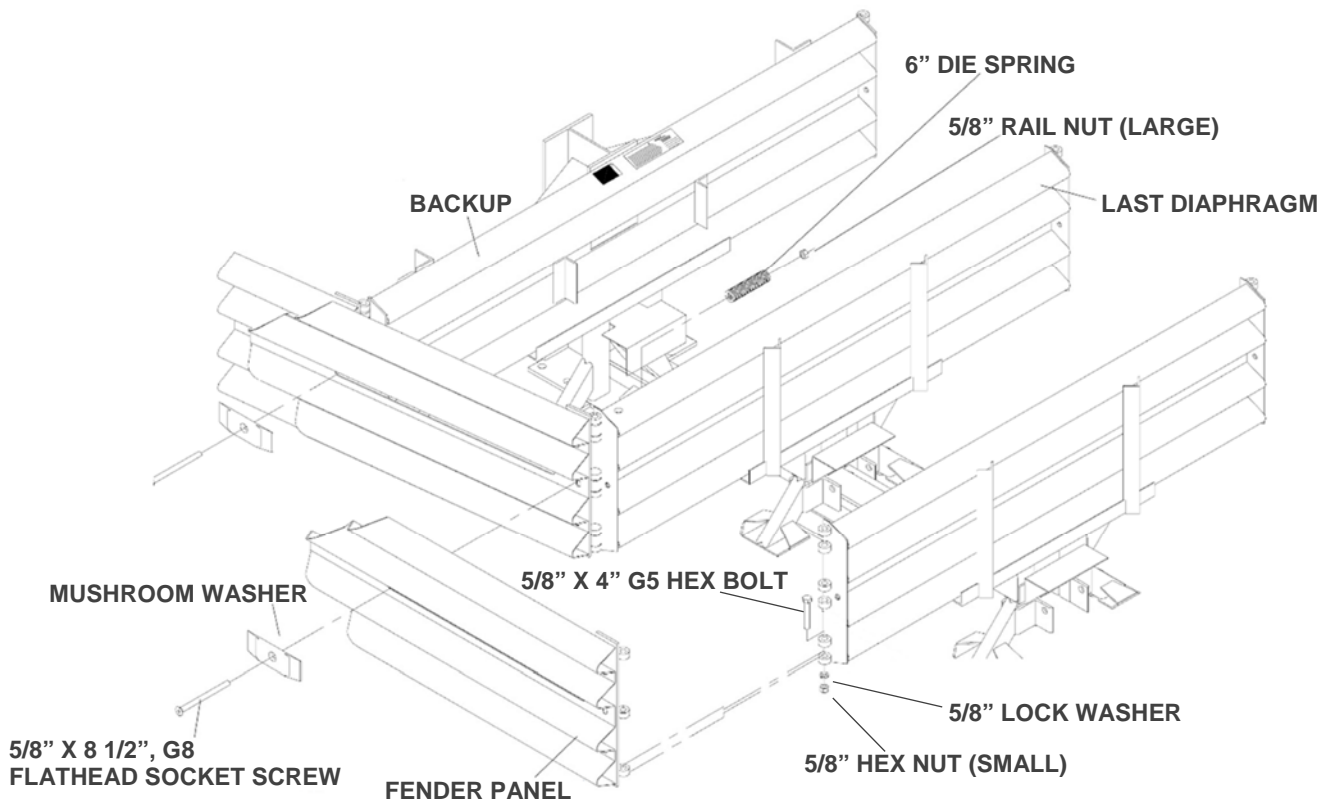


Figure 63
Wide Fender Panel Assembly

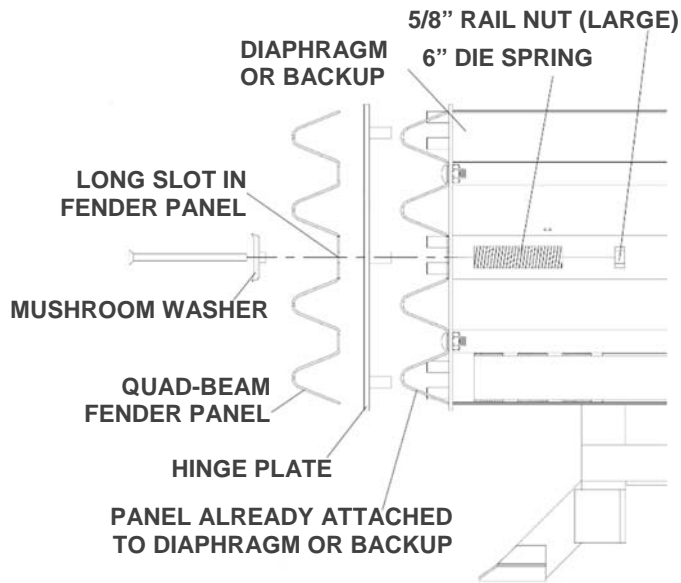


Figure 63A
Mushroom Washer Attachment

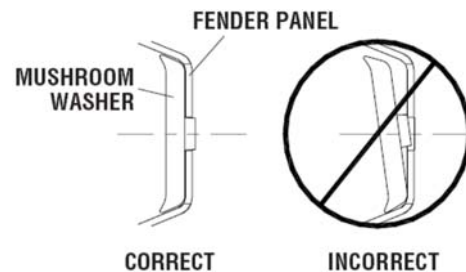


Figure 63B
Mushroom Washer Orientation

Step 6

Check Diaphragm spacing to ensure 36" [915 mm] between rear faces of consecutive Diaphragms as shown in Figure 64 and Fender Panel Assembly drawing.

Step 7

Once the proper spacing has been achieved, tighten the Mushroom Washer Assembly (large rail nut) until it reaches the end of the threads. Assemble the remaining Diaphragms and Fender Panels following the same procedures. Tighten rail nut (large hex) at the front of the Fender Panels. Ensure the rail bolt shoulder is seated within the Fender Panel slot.

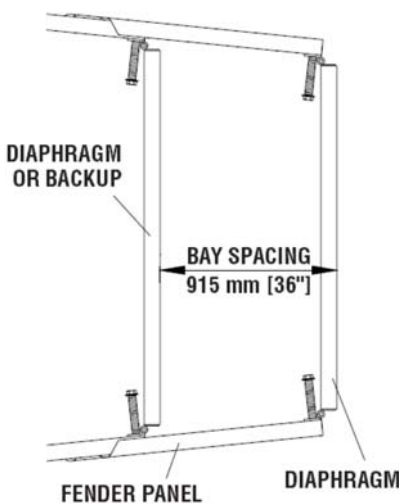


Figure 64
Proper Diaphragm Spacing

9) Attach End Cap

Using 5/8" x 3 1/2" G5 hex bolt, 5/8" hex nut and 5/8" lock washer, attach the End Cap to the front of the first Monorail segment.

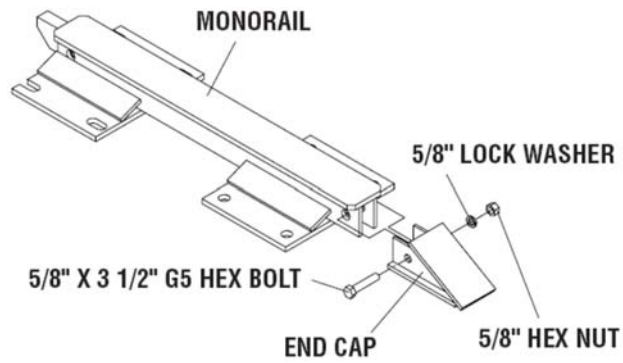


Figure 65
Monorail End Cap Assembly

10) Attach Cartridge Support Brackets

Attach Cartridge Support Bracket to all Diaphragms and Backup as shown in Figures 66 - 69, the Backup Assembly drawing, and the Diaphragm Assembly drawing.

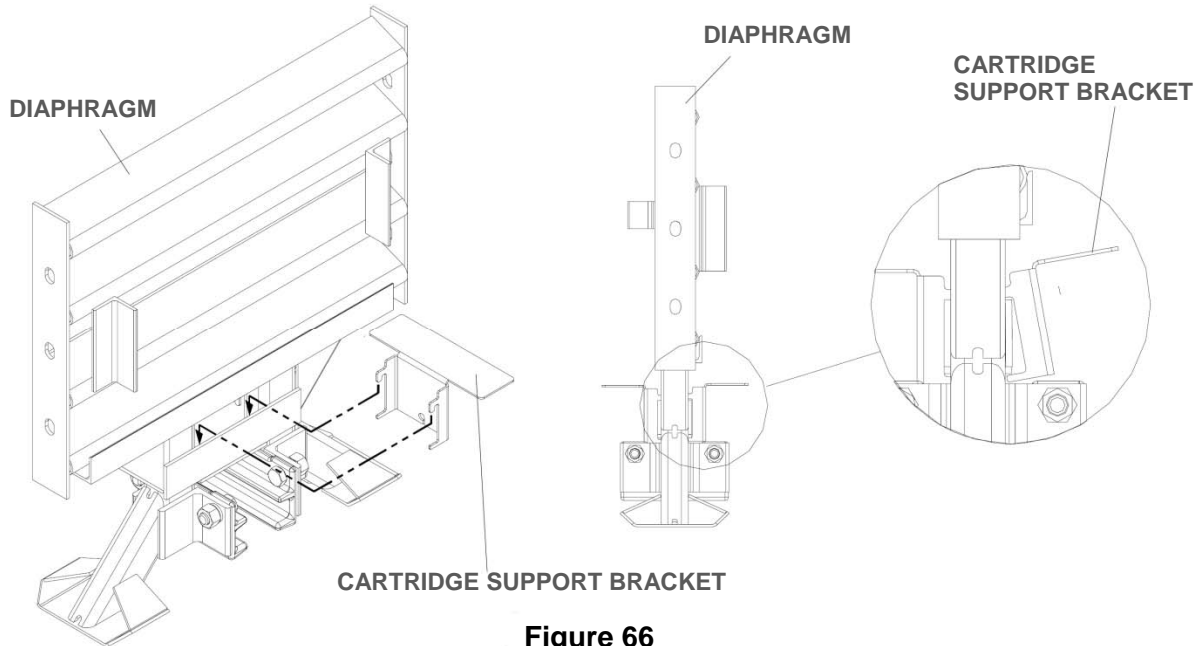


Figure 66
Diaphragm with
Cartridge Support Bracket

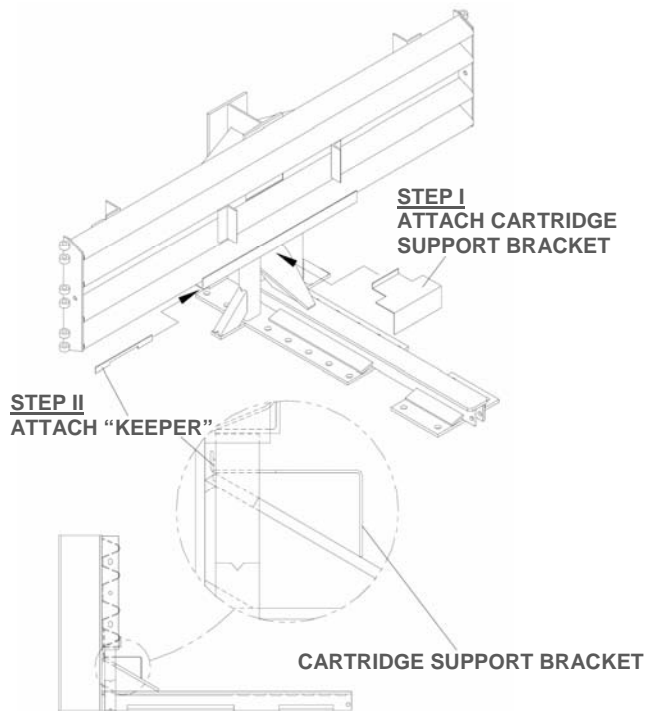


Figure 67
Cartridge Support Bracket
(Tension Strut Backup)

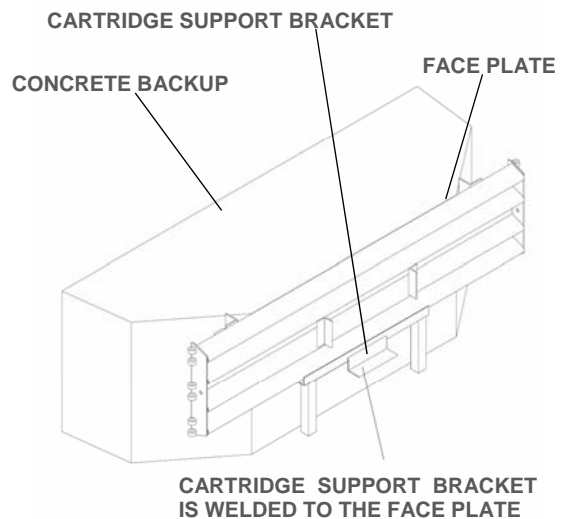


Figure 68
Cartridge Support Bracket
(Concrete Backup)

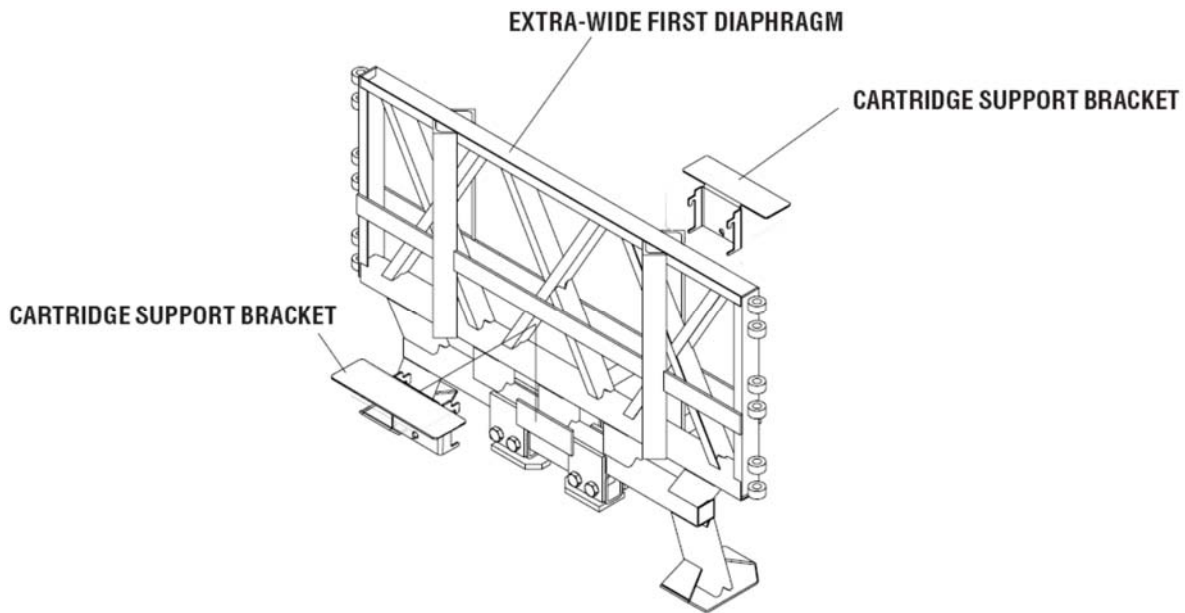


Figure 69
Extra-Wide First Diaphragm with Cartridge Support Bracket
(See Drawing Package)

11) Attach Nose Assembly

See pages 36 and 37 for Nose Assembly instructions.

12) Checking the System Assembly

Recheck to ensure that all fasteners are properly tightened throughout the system (anchor bolts, etc.). Review torque requirements below and inspect all Fender Panels. If they do not fit tightly against the underlying Fender Panels, system realignment may be necessary (Figure 70). Verify top of Steel Nose height is 32 1/8" above the roadway (p. 36).



Warning:
Anchor Requirements
Anchor Studs – Anchoring Information Table, p. 16 May slightly protrude above nuts
Critical Clearances
Anchor Studs above nuts – p. 46, Figure 54 Fender Panel Gap Wide – 1.00" [25 mm] see below

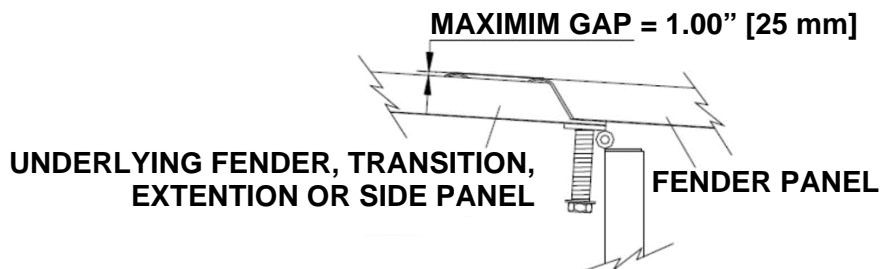


Figure 70
Fender Panel Gap for Wide Systems

13) Cartridge Placement

Ensure the Adjustable Cartridge Support in the Nose is attached correctly (p. 36). The top surface of the Nose Cartridge should be horizontal.

To complete the assembly of a QuadGuard® II, place the appropriate Cartridge in each Bay and Nose section of the system. Type I Cartridges are placed toward the front (Nose) of the system; Type II Cartridges are placed toward the rear (Backup) of the system (Figures 71 and 72). Ensure all Cartridges are pointed toward the front of the system per Cartridge direction arrow.



Warning: Placing the wrong Cartridge in the Nose or any Bay will result in system performance that has not been crash tested pursuant to the NCHRP Report 350 criteria.

I - TYPE I CARTRIDGE
II - TYPE II CARTRIDGE

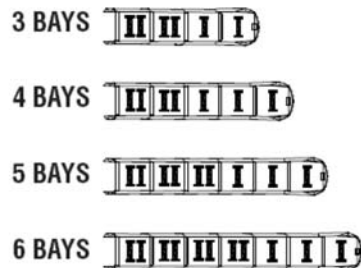


Figure 71
Cartridge Placement

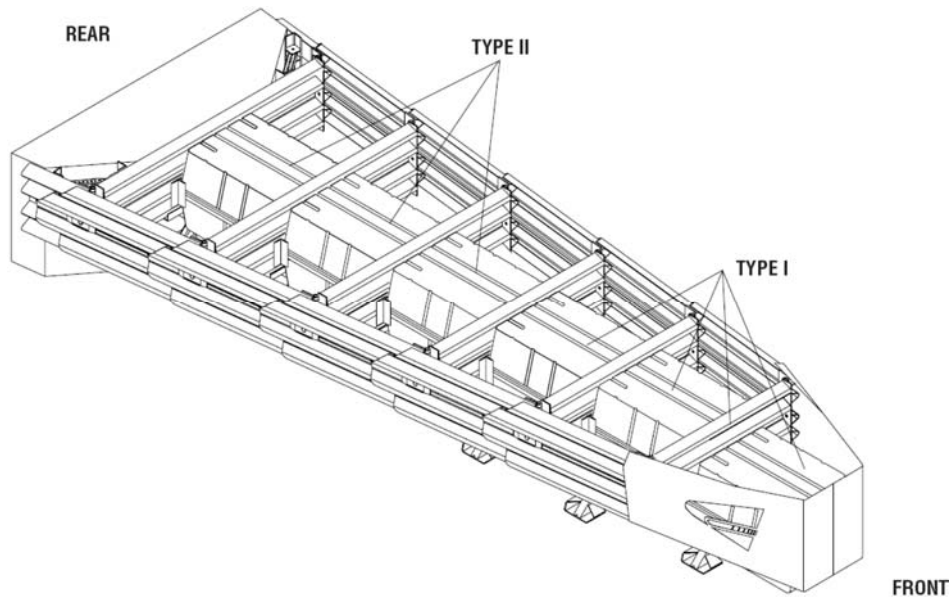


Figure 72
Five Bay System

QuadGuard® II Final Inspection Checklist

Date: _____

Site Location: _____

Inspector: _____

Refer to the QuadGuard® II manual and/or drawing package.

- Minimum clearance of 30" behind rear Fender Panels for movement (p. 15)
- Proper Transition Panel is used for the type of barrier (p. 24, 42)
- Every borehole and slot in Backup and Monorail is utilized (p. 25, 27, 28, 45, 46, 47)
- Anchor stud(s) height is 1.5" or less above the pad (p. 27)
- If no transition is used, narrow side panels are used with backup (p. 29, 48)
- Monorail guides are attached to the Diaphragms with shims (p. 30, 49)
- Mushroom Washer tabs lay flat within fender panel slots (p. 32, 51)
- Mushroom Washer nuts are bottomed out to shank on Mushroom Washer bolt (p. 32, 52)
- Monorail End Cap Assembly in place (p. 33, 53)
- Cartridges are level and the same height in each Bay (p. 39)
- Nose Cartridge is level (p. 36)
- Fender Panel gap is 7/8" or less for Narrow (parallel) systems (p. 38)
- Fender Panel gap is 1" or less for Wide (flared) systems (p. 55)
- Cartridge types are in order, correctly seated, and facing the front of the system (p. 39, 56)
- Bolts and nuts are properly tightened throughout the system (p. 38, 55)
- Anchor nuts are torqued to adhesive manufacture specification (p. 16)
- System is clear of debris



Important: It is critical that you inspect this product after assembly is complete to make certain that the instructions provided in this manual have been strictly followed.

Maintenance and Repair

Inspection Frequency

Inspections are recommended as needed based upon volume of traffic and impact history. Visual Drive-By Inspections are recommended at least once a month. Walk-Up Inspections are recommended at least twice a year for QuadGuard® II Narrow systems on asphalt (p. 16).

Visual Drive-By Inspection

- 1) Check to see if there is evidence of an impact. If so, a walk-up inspection will be necessary.
- 2) Check to see if the Cartridges appear to be off the Support Brackets. Any damaged Cartridges will need to be replaced.



Warning: See Cartridge placement instructions on pages 39 and 56.

- 3) Verify the Steel Nose is properly attached and at 32 1/8" above roadway surface.
- 4) Note the location and condition of the QuadGuard® II and the date of visual drive-by inspection.

Walk-Up Checklist

- Clear and dispose of any debris on the site.
- Clear and remove excessive dirt from around the Monorail and Diaphragm feet.
- Fasteners (nuts/bolts) are tight and rust free.
- Anchor bolts are securely anchored.
- Diaphragm legs are straight.
- All Mushroom Washer Assemblies are properly seated.
- Fender Panels and Transition Panels should nest tightly against the system.
- Cartridges have not been damaged and are properly seated on their Support Brackets. To ensure intended speed characteristics, partially crushed Cartridges (due to low speed impacts) must be replaced.
- Post-Impact Instructions (p. 59)
- To determine if a product should be replaced or is potentially reusable, a trained engineer experienced in highway products and directed by the DOT, or other appropriate local highway authority, must be consulted.

Post-Impact Instructions



Important: It is the sole responsibility of the project engineer and/or the local highway authority and its engineers to determine whether use or reuse of any part of the system is appropriate or acceptable following an impact. Trinity Highway makes no recommendation or suggestion regarding this determination. Each impact is unique.



Warning: If the QuadGuard® II Narrow system is anchored to asphalt and less than 10% of the total anchors are damaged, then each damaged anchor must be replaced. If more than 10% of the anchors are damaged, then the system must receive a fresh, undisturbed asphalt foundation and be redeployed using 18" [460 mm] threaded rods.

Narrow (Parallel) Systems

- 1) Deploy the appropriate traffic-control devices for protection.
- 2) Check to see that all anchor bolts have remained firmly anchored in the roadway surface. Replace any that are loose, broken, or pulled out.

The proper performance of the system depends on the Monorail anchors being properly anchored.

- 3) Clear and dispose of any debris on the site.
- 4) Check the system to be certain that the Mushroom Washer Assemblies holding the Fender Panels together are still intact and that the system has not been deformed in a way that would prevent pulling it back to its original position.
- 5) Be sure that the Diaphragm Support Legs are all properly attached to the Monorail.

Wide (Flared) Systems

- 1) Deploy the appropriate traffic-control devices for protection.
- 2) Check to see that all anchor bolts have remained firmly anchored in the roadway surface. Replace any that are loose, broken, or pulled out.



Important: Performance of the system depends on the Monorail Anchors being properly anchored.



Caution: QuadGuard® II wide systems should not be anchored to asphalt.

- 3) Clear and dispose of any on site debris.
- 4) Check the system to be certain that the Mushroom Washer Assemblies holding the Fender Panels together are still intact and that the system has not been deformed in a way that would prevent pulling it back to its original position.
- 5) Ensure that each Diaphragm is properly attached to the Monorail.

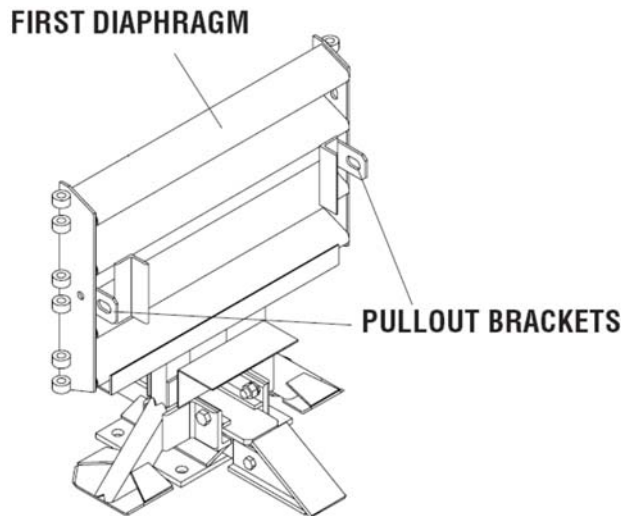


Caution: Use eye protection and gloves when refurbishing the Mushroom Spring Assembly. Do not place fingers underneath an assembled Mushroom Washer. Parts may suddenly shift and fingers may be pinched. If the spring is still under compression as the nut is nearing the end of the bolt, to prevent injury, make sure that the spring is restrained with a clamp so it does not suddenly release when nut is removed from the Mushroom Washer Bolt.

- 6) Attach chain to Pullout Brackets on first Diaphragm (Figure 73). Attach both ends of chain to a heavy vehicle (such as a 1 ton pickup).



Warning: Stand clear in case chain breaks or becomes disconnected.



**Figure 73
Pullout**



Important: Slowly pull the QuadGuard® II forward until the system reaches its original length. Have someone watch the system during repositioning to be certain previously undetected damage does not cause the Diaphragms to bind or pull out improperly.

- 7) Remove all crushed Cartridges from within the system.
- 8) Check to see that the Diaphragms are in usable condition. Diaphragms which are bowed or have bent legs must be replaced.
- 9) Check that the Fender Panels are properly attached with the Mushroom Washer Assemblies. Damaged Fender Panels and Transition Panels must be replaced



Warning:	
Fender Panel	Maximum gap allowed:
Narrow Systems	7/8" [22 mm]
Wide Systems	1.00" [25 mm]

10) Check the **gaps between Fender Panels**. The maximum gap allowed for these overlapping parts (including Fender Panels overlapping Panels behind the system) is 7/8" [22 mm] for **narrow systems** and 1.00" [25 mm] for **wide systems**. Be sure the Mushroom Washer Assemblies are tightened to the end of the threads. If the gaps between the Fender Panels are still too large, it may be necessary to replace bent parts.

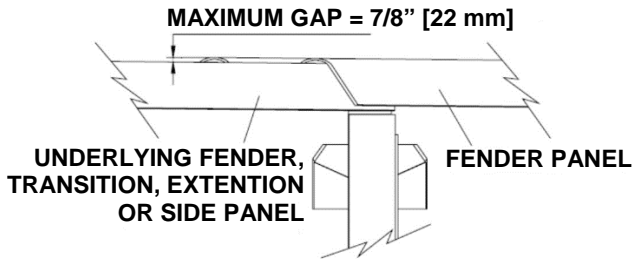


Figure 74
Narrow Systems Fender Panel Gap

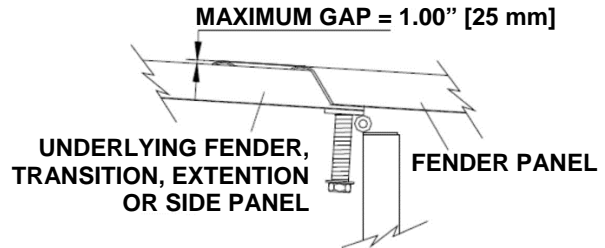


Figure 75
Wide Systems Fender Panel Gap

- 11) Replace all crushed Cartridges. See Cartridge Placement on pages 39 and 56.
- 12) Remove damaged Nose Assembly and attach the new Nose (p. 36 and 37).



Important: Trinity Highway makes no recommendation whether use or reuse of any part of the system is appropriate or acceptable following an impact. It is the sole responsibility of the project engineer and/or the local highway authority and its engineers to make that determination. It is critical that you inspect this product after assembly is complete to make certain that the instructions provided in this manual have been strictly followed.



Warning:
Anchor Requirements
Anchor Studs – p. 16
Critical Clearances
Anchor Studs above nuts – Figure 54, p. 46 Fender Panel Gap Narrow – 7/8" [22 mm] Fender Panel Gap Wide – 1.00" [25 mm]

- 13) Verify all bolts on the system are tight (p. 16).
- 14) Ensure that the site is free from any debris.
- 15) The QuadGuard® II is now ready for use.

Parts Ordering Procedure

Make a list of all damaged parts using part descriptions shown on the components pages 7 - 11 and on the system images (p. 63 and 64). Answer the following questions in the spaces provided. This information is necessary to receive the proper parts.

QuadGuard® II Ordering Information Chart		
Description:	Choices	Fill in this section
What is the width of the system (p. 21)?	24" [610 mm] 30" [760 mm] 36" [915 mm] 48" [1219 mm] 69" [1755 mm] 90" [2285 mm] 126" [3200 mm]	
What is the Number / Type of Bays? See Bay information on pages 39 and 56.	Narrow Systems: 1 through 5 Wide Systems: 3 through 6	
What Type of Backup Does the System Have? Figures 9 or 10 (p. 23).	Concrete Tension Strut	
What Type of Transition Panel? Reference "Side Panel and Transition Panel Types" (pp. 24 and 42). Be sure to specify right side, left side, or no Transition(s). See "How to Determine Left/Right" on page 20.	Quad to W Quad to Thrie Quad to Safety Shape Barrier Quad to End Shoe 4" Offset Panel	

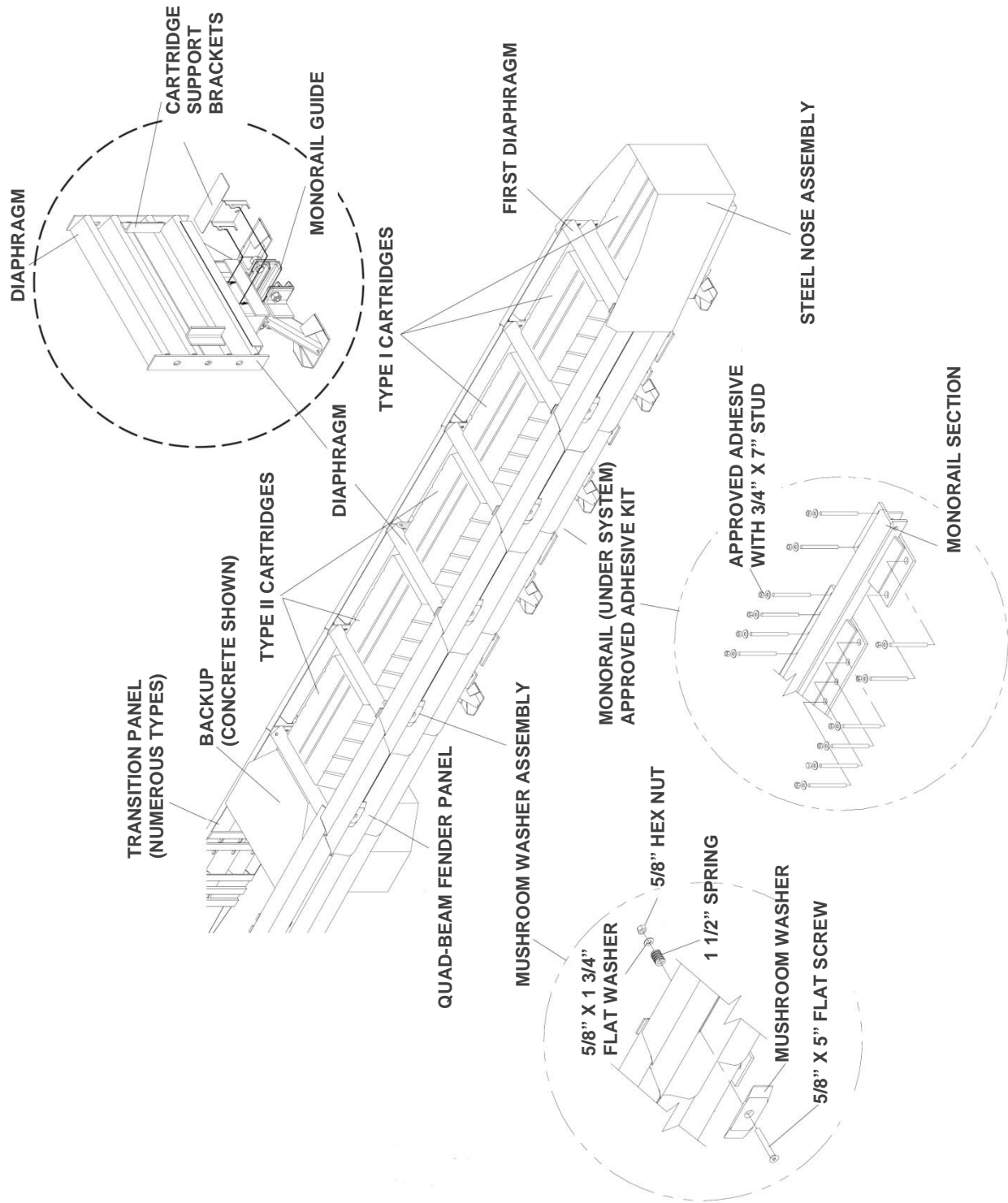


Figure 76
QuadGuard® II for Narrow
Roadside Obstacles

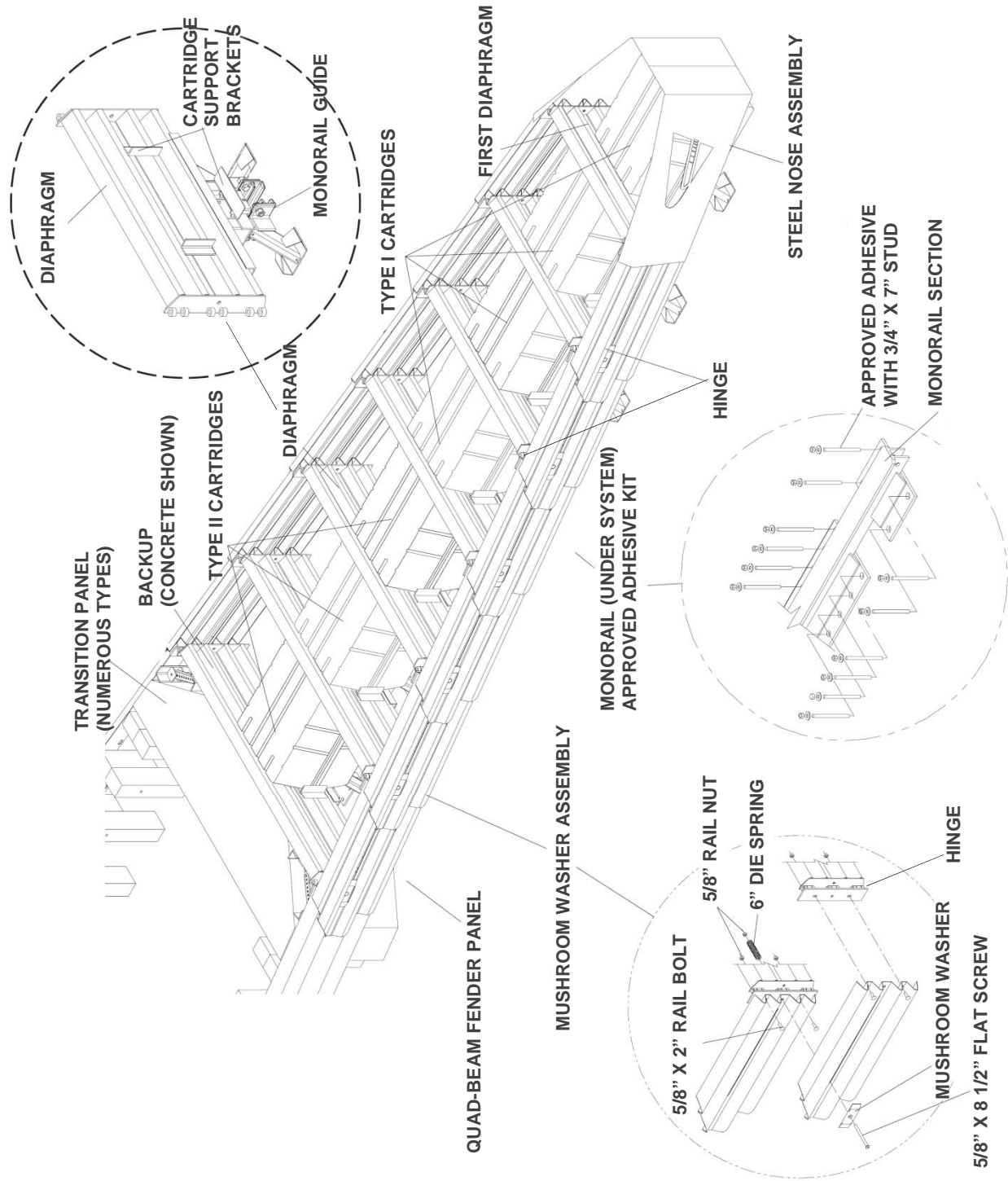


Figure 77
QuadGuard® II for Wider
Roadside Obstacles

Notes:

Notes:



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