

米国における接着系アンカーの知見 (TA5140.30)

NTSB : 米国国家安全運輸委員会

FHWA : 米国連邦道路庁

(委員会指摘事項に対する報告)

平成25年3月27日(水)

ボストンでのトンネル天井板落下事故後の対応の流れ

日付	事象・対応	原文
2006.07.10 (H18)	ボストンの州間高速道路90号線でトンネル天井板落下事故発生。	
2007.07.10	国家安全運輸委員会(NTSB)が事故の報告書を公表し、連邦道路庁等の道路管理機関や技術基準制定組織等に対して安全勧告を実施。その中で、現場での対応方法や新たな基準の制定等を提言。	
2007.10.17	連邦道路庁(FHWA)が技術的勧告(T5140.26)を発出して、事故の原因となった速硬性エポキシ樹脂の製品リストを公表し、連邦政府助成事業での対応方法を提示。	添付1
2008.03.21	速硬性エポキシ樹脂の製品リストを増強するために、FHWAがT5140.26を無効にして新たな技術的勧告(TA5140.30)を発出。 ⇒TA5140.30の要約が次ページ以降に有り。	添付2
2009.08.12	交通運輸会議(TRB)が持続荷重下での接着系アンカーについて研究報告書を発表。その中で、米国全州道路交通運輸行政官協会(AASHTO)の持続荷重下での接着系アンカーの性能試験基準の案を作成。	
2010(H22)	AASHTOが持続荷重下での接着系アンカーの性能試験基準を制定。	

【TA5140.26の要約】速硬性エポキシ樹脂の使用制限

添付1

■事故の主原因は持続引張荷重に対して抵抗性能の無い速硬型エポキシ樹脂

「Sikadur AnchorFix-3」を接着剤として使用していたことであつたとされ、下記に該当する接着剤の製品のリストを公開し、これらの製品を接着系アンカーに使用しないよう呼びかけている。(リストは更新が続けられ、現時点での最終更新は2011年6月4日)

- ① Sika社により製造された速硬型エポキシ樹脂「Sikadur AnchorFix-3」
- ② OEMにより「Sikadur AnchorFix-3」を別名で販売している製品
- ③ Sika社が製造するエポキシ樹脂用速硬性硬化剤を使用している製品

■当時の接着系アンカーの性能確認試験に関する基準は、**道路構造物の供用期間(75年～100年)に渡ってその安全性能を保証するようなものではなかった。**

■標準硬化型エポキシ樹脂を接着剤として用いた接着系アンカーの使用については、「追加のTA5140.30の規定」に拠るとされているが、現時点で追加の規定は確認できない。

速硬性エポキシ樹脂だけについて使用しないように言われたものであり、それ以外の樹脂(ポリエステル系樹脂等)については言及されなかった。

【TA5140.30の要約】接着系アンカーの取扱い

添付2

連邦政府の助成事業における接着系アンカーの取扱いが設定された。

■新規事業

- ① 接着系アンカーに速硬型エポキシ樹脂は使用しないこと。
- ② 長期持続引張荷重が作用する箇所或いは懸垂構造となる箇所には、長期間のクリープ性能を保証し、また懸垂構造の影響を認識した、改良された認証過程をFHWAが認めるまで、接着系アンカーを使用しないこと。

■既存事業(既設構造物)

- ① 持続引張荷重が作用する箇所に速硬型エポキシ樹脂の接着系アンカーが使用されている場合には、そのアンカーを改造するか信頼性のある適切な金属系アンカーに取替えること、かつ取替えが行われるまでは厳密な点検を定期的に行うことが強く推奨される。
- ② 持続引張荷重が作用する箇所に速硬性エポキシ樹脂以外の接着剤又は製造元が不明の接着剤を使用したアンカーが使われている場合には、アンカーの長期間の性能に関する信頼性を適切なレベルに維持するために、重要性や代替性を考慮した厳密な定期点検の体制を確立することが強く推奨される。そのためには、現場毎に異なる接着剤の強度及び構造物の期待される供用期間に渡るクリープ特性を定めるための試験方法を開発する必要があると考えられる。

This directive was **canceled** March 21, 2008



U.S. Department
of Transportation
**Federal Highway
Administration**

Technical Advisory

Subject
Use and Inspection of Adhesive Anchors in Federal-Aid Projects

Classification Code	Date	Office of Primary Interest
T 5140.26	October 17, 2007	HIBT-10

Par.

1. What is the purpose of this Technical Advisory?
2. Does this Technical Advisory supersede another Technical Advisory?
3. What is the definition of "Fast Set epoxy"?
4. What is this background of this Technical Advisory?
5. What are the recommendations for new Federal-aid projects and existing projects?

1. **What is the purpose of this Technical Advisory?** The purpose of this Technical Advisory is to provide guidance and recommendations regarding the use and in-service inspection of adhesive anchors, including those utilizing "Fast Set epoxy" (see definition in paragraph 3), in sustained tension applications on all Federal-aid highway projects.
2. **Does this Technical Advisory supersede another Technical Advisory?** No. This is a new Technical Advisory.
3. **What is the definition of "Fast Set epoxy"?** "Fast Set epoxy" refers to an epoxy produced by the Sika Corporation called Sikadur AnchorFix-3. This epoxy is also repackaged and distributed by the following names/companies:
 - a. Power-Fast+ Epoxy Injection Gel Fast Set Formula by Powers Fasteners, Inc.
 - b. NRC 1000 Gold Premier Epoxy Fast Set Formula by Newman Renner Colony, LLC.
 - c. Foil-Fast Epoxy Injection Gel Fast Set Formula by the Rawlplug Company, Inc.
4. **What is this background of this Technical Advisory?**

- a. On July 10, 2006, a portion of the suspended ceiling system of the I-90 connector tunnel in Boston, Massachusetts, collapsed onto a passing car killing the passenger and injuring the driver. The suspended ceiling in the collapsed section was comprised of concrete panels connected to steel hangers suspended from the tunnel concrete ceiling by an adhesive anchor system consisting of stainless steel anchor rods embedded in epoxy. Immediately after the accident, the Federal Highway Administration (FHWA) launched an independent study and testing plan to determine the probable cause of failure of the suspended ceiling system.
- b. The testing plan consisted of short-term strength and long-term performance testing of the adhesive anchor system installed in the I-90 connector tunnel, as well as an experimental parametric study and a limited sustained load characterization study on the adhesive anchor system supplied for use in the I-90 connector tunnel conducted at the FHWA's Turner-Fairbank Highway Research Center (TFHRC). The testing program identified several installation factors that affect the short-term strength of adhesive anchors. However, while these factors may have contributed to the timing of the failure, the results clearly show that the primary cause of the collapse was the use of Fast Set epoxy which is incapable of resisting sustained tension loads without excessive creep.
- c. In addition to the testing conducted on the adhesive used in the I-90 tunnel, data produced at TFHRC show that some anchor systems utilizing adhesives other than Fast Set epoxy that have passed the International Code Council (ICC) creep certification process are still vulnerable to creep under typical bridge and tunnel exposure conditions. The results indicate that the current American Society for Testing and Materials (ASTM) and the ICC creep prediction methodology do not appear to guarantee safe performance of adhesive anchors over the entire expected service life (75 to 100 years) of transportation structures. In addition, the ICC does not address issues related to overhead installation of anchors nor the effect that vibration could have on their long-term performance and integrity.
- d. Therefore, as a result of the investigation of the collapsed suspended ceiling support system, and in concurrence with the National Transportation Safety Board's findings, the FHWA is now implementing these safety recommendations to ensure that similar incidents will not occur in the future. This Technical Advisory applies to new and existing Federal-aid highway projects.

5. What are the recommendations for new Federal-aid projects and existing projects?

a. New Federal-aid projects

(1) This Technical Advisory strongly discourages the use of Fast Set epoxy for adhesive anchor applications.

(2) This Technical Advisory also strongly discourages anchor systems utilizing adhesives other than Fast Set epoxy for permanent sustained tension applications or overhead applications until the FHWA is satisfied that an improved certification process has been developed to ensure long-term creep performance and that recognizes the effect of overhead installation.

b. Existing projects

(1) Where applications are those specific to the use of Fast Set epoxy adhesive in sustained tension, it is strongly recommended the anchors be retrofitted and/or replaced with a reliable and appropriate mechanical anchor system and that rigorous and regular inspections are performed in the interim.

(2) Where applications of anchor systems in sustained tension using adhesives other than Fast Set epoxy or from an unknown source have been identified, instituting a rigorous and regular inspection program that considers importance and redundancy is strongly recommended to maintain an appropriate level of confidence in their long-term performance. This may require developing a testing protocol and program to determine the site specific ultimate capacities and creep characteristics of the adhesive over the expected life of the structure.



King W. Gee
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Technical Advisory

Use and Inspection of Adhesive Anchors in Federal-Aid Projects

March 21, 2008

Technical Advisory 5140.30

What is the purpose of this Technical Advisory?

The purpose of this Technical Advisory is to provide guidance and recommendations regarding the use and in-service inspection of adhesive anchors, including those utilizing "Fast Set epoxy" (see definition in paragraph 3), in sustained tension applications on all Federal-aid highway projects.

Does this Technical Advisory supersede another Technical Advisory?

Yes. This Technical Advisory supersedes Technical Advisory T 5140.26, dated October 17, 2007, by updating the list of "Fast Set epoxies" identified in paragraph 3. Technical Advisory T 5140.26 is herein cancelled.

What is the definition of "Fast Set epoxy"?

"Fast Set epoxy" refers to an epoxy produced by the Sika Corporation called Sikadur AnchorFix-3. This epoxy is also repackaged and distributed by the names/companies presented in a list of adhesives available from the Federal Highway Administration (FHWA) Web site at the following Web link: <http://www.fhwa.dot.gov/Bridge/adhesives.cfm>. FHWA will update this list as new information becomes available and encourages visitation to this Web site for the latest updates.

What is the background of this Technical Advisory?

1. On July 10, 2006, a portion of the suspended ceiling system of the I-90 connector tunnel in Boston, Massachusetts, collapsed onto a passing car, killing the passenger and injuring the driver. The suspended ceiling in the collapsed section was comprised of concrete panels connected to steel hangers suspended from the tunnel concrete ceiling by an adhesive anchor system consisting of stainless steel anchor rods embedded in epoxy. Immediately after the accident, the FHWA launched an independent study and testing plan to determine the probable cause of failure of the suspended ceiling system.
2. The testing plan consisted of short-term strength and long-term performance testing of the adhesive anchor system installed in the I-90 connector tunnel, as well as an experimental parametric study and a limited sustained load characterization study on the adhesive anchor system supplied for use in the I-90 connector tunnel conducted at the FHWA's Turner-Fairbank Highway Research Center (TFHRC). The testing program identified several installation factors that affect the short-term strength of adhesive anchors. However, while these factors may have contributed to the timing of the failure, the results clearly

show that the primary cause of the collapse was the use of "Fast Set epoxy" which is incapable of resisting sustained tension loads without excessive creep.

3. In addition to the testing conducted on the adhesive used in the I-90 tunnel, data produced at TFHRC show that some anchor systems utilizing adhesives other than "Fast Set epoxy" that have passed the International Code Council (ICC) creep certification process are still vulnerable to creep under typical bridge and tunnel exposure conditions. The results indicate that the current American Society for Testing and Materials (ASTM) and the ICC creep prediction methodology do not appear to guarantee safe performance of adhesive anchors over the entire expected service life (75 to 100 years) of transportation structures. In addition, the ICC does not address issues related to overhead installation of anchors nor the effect that vibration could have on their long-term performance and integrity.
4. Therefore, as a result of the investigation of the collapsed suspended ceiling support system, and in concurrence with the National Transportation Safety Board's findings, the FHWA is now implementing these safety recommendations to ensure that similar incidents will not occur in the future.
5. At the time T 5140.26 was issued, the FHWA was aware of the four products originally listed in paragraph 3 as being inadequate. Since that time, the investigation has continued to identify adhesives that are repackaged Sika products that include the fast set hardener (part B of the epoxy). These repackaged adhesives have been added to the original list so that structure's owners are aware of the potential for creep issues associated with these products.

What are the recommendations for new Federal-aid projects and existing projects?

a. New Federal-aid projects

(1) This Technical Advisory strongly discourages the use of "Fast Set epoxy" for adhesive anchor applications.

(2) This Technical Advisory also strongly discourages the applications of anchor systems utilizing adhesives other than "Fast Set epoxy" for permanent sustained tension applications or overhead applications until the FHWA is satisfied with an improved certification process that is developed to ensure long-term creep performance and that recognizes the effect of overhead installation.

b. Existing projects

(1) Where applications are those specific to the use of "Fast Set epoxy" adhesive in sustained tension, it is strongly recommended the anchors be retrofitted and/or replaced with a reliable and appropriate mechanical anchor system and that rigorous and regular inspections are performed in the interim.

(2) Where applications of anchor systems in sustained tension using adhesives other than "Fast Set epoxy" or from an unknown source have been

identified, instituting a rigorous and regular inspection program that considers importance and redundancy is strongly recommended to maintain an appropriate level of confidence in their long-term performance. This may require developing a testing protocol and program to determine the site specific ultimate capacities and creep characteristics of the adhesive over the expected life of the structure.

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Structures

[FHWA](#) > [Bridge](#) > [Tunnels](#) > [TA 5140.30](#) > List of Adhesives

- [Accelerated Bridge Construction](#)
- [Fiber Reinforced Polymer Composites](#)
- [High Performance Steel](#)
- [High Strength Bolts](#)
- [Integrated Bridge Project Delivery and Life Cycle Management](#)
- [Load and Resistance Factor Design](#)
- [Prefabricated Bridge Elements and Systems](#)
- [Segmental Concrete Bridge Technology](#)
- [Seismic](#)
- [Steel Fabrication](#)
- [Tunnels](#)

TA 5140.30

List of Adhesives

On July 10, 2006, a portion of the suspended ceiling system of the I-90 connector tunnel in Boston, MA collapsed onto a passing car killing the passenger and injuring the driver. The suspended ceiling in the collapsed section was comprised of concrete panels connected to steel hangers suspended from the tunnel concrete ceiling by an adhesive anchor system consisting of stainless steel anchor rods embedded in epoxy. The probable cause of failure of the suspended ceiling system was determined to be the use of an adhesive without adequate resistance to creep.

As a result of this determination the FHWA issued Technical Advisory TA 5140.26, Use and Inspection of Adhesive Anchors in Federal-Aid Projects, to implement safety recommendations to ensure that similar incidents will not occur in the future. At the time TA 5140.26 was issued, it identified the four adhesives products that FHWA was aware were inadequate. Since that time, the investigation has continued to identify adhesives that are re-packaged Sika products that include the fast set hardener (part B of the epoxy). To insure that the best, most up to date information is widely available on these inadequate adhesives, FHWA cancelled TA 5140.26 and issued [TA 5140.30](#), UPDATE: Use and Inspection of Adhesive Anchors in Federal-Aid Projects. Paragraph 3 of [TA 5140.30](#) directs readers to this webpage for a list of adhesives that are defined as "Fast Set epoxy".

The products listed below were manufactured or distributed with both Fast Set and Standard Set epoxies prior to January 2008. All manufacturers have reportedly discontinued the use of Fast Set epoxy in their products since January 2008. The FHWA is not, however, involved in overseeing the manufacture of epoxies and does not certify any epoxy's properties.

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For new projects, a State is advised to ascertain that any adhesive it uses does not contain the Fast Set epoxy. For existing projects, if a State cannot determine if Fast Set or Standard Set epoxy was used (for example, an old invoice or inventory list does not say which formula was used in the epoxy), the State should follow the advice of Part 5 of the Technical Advisory TA 5140.30.

The use of adhesive anchors with Standard Set epoxy is subject to further recommendations of Technical Advisory TA 5140.30.

These additional adhesives are listed below separated by distributor. As this is a living inventory of Fast Set epoxy "also known as" (AKAs), it will be updated as new information is developed.

- Last Review: October 16, 2008
- Last Addition: October 16, 2008

Sika Corporation

- Sikadur AnchorFix-3
- Sika/Rawl FoilFast
- Sika/Rawl FoilFast (fast set)
- Sika/Rawl FoilFast FS
- Sikadur 881 DBA
- Sikadur DOT-SP3
- Sikadur Injection Gel AnchorFix 3
- Sikadur Injection Gel Fast set

Powers Fasteners, Inc.

- Power-Fast+ Epoxy Injection Gel Fast Set Formula
- Power-Fast + (Fast Set)
- Power-Fast Injection Gel (Fast Set)
- Power-Fast+ Quick Shot (Fast Set)
- Powers Quick Shot (Fast Set)
- Powers Rawl Injection Gel Fast Set

Newman Renner Colony, LLC. (Private Labeling of Power Fast Epoxy)

- NRC 1000 Gold Premier Epoxy Fast Set Formula
- NRC - FS Epoxy
- NRC-1000 Gold (Fast Set)

Rawlplug Company, Inc.

- Foil-Fast Epoxy Injection Gel Fast Set Formula
- Foil Fast Epoxy Injection Gel
- Rawl/Sika Foil Fast Set

Action Bolt & Supply, Inc. or Wurth Action Bolt & Tool Co. (Private Labeling of Power Fast Epoxy)

- Action Bolt A1000 FS
- Action Bolt A1000 QS (Fast Set)
- Action Bolt A1000 Quick Shot (Fast Set)

Allied Tool and Fastener (Private Labeling of Power Fast Epoxy)

- Allied A-1000 (Fast Set)
- Allied Gold (A-1000) (Fast Set)
- A-1000 (Fast Set)
- Allied Gold A-100 (Fast Set)

All Construction Fastening Systems, FL (Private label of Power Fast Epoxy)

- ACFS A-1000 (Fast Set)

Additional Private Labelings of Power Fast Epoxy

- Hillman Power Fast + Quick Shot (Fast Set)
- R-Kex FS (Rawl UK)

Private labeling by Sika of AnchorFix 3

- Tamms Anchor Gel
- Tamms Rapid Set Epoxy Gel

Also the following foreign sold adhesives are suspected:

- Sika Scellement Epoxy (Europe)
- PowerFast PLUS (Australia)

Updated: 04/06/2011

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