



Date: August 6, 2020
To: Frank Girardi, Executive Director Capital Program, Facilities and Construction
From: Daniel W. Jardine, Program Director, CBRE | Heery
Subject: Terracon Report Clarifications

MEMORANDUM

CBRE | Heery engaged Terracon to perform the following services:

- Review of the BCPS Roofing Design and Material Standards and Specifications.
- Review the 2017 Florida Building Code and State Requirements for Educational Facilities (SREF) to evaluate which BCPS standards are Code or preferences.
- Evaluate the preferences (such as wind rider warranties) and provide an estimate of the cost increases for preferences or options. Consult with roofing manufacturers to obtain cost impact information.
- Identify up to three approved manufacturers and specific systems which are able to provide roofing systems that comply with BCPS Standards.
- Provide analysis and recommendations for CBRE/Heery and BCPS.

In addition, please find enclosed the Terracon Roofing Design Standards Review and System Proposals Report and Addendum to Report.

The following are responses and points of clarification based on CBRE | Heery's assessment of the Terracon Roofing Design Standards Review and System Proposals and Addendum to Report. The CBRE | Heery clarifications are noted as "CBRE| Heery Responses and Clarifications".

Roofing Design Standards Review and System Proposals - 3.2 BCPS Standards Review - Page 5

The BCPS roofing standards permit bituminous roofing systems on school facilities. Our focus for this evaluation was on the modified bitumen roof system specification. Our understanding is that there is a preference within the District for one manufacturer (Soprema) of modified bitumen membranes.

CBRE| Heery Responses and Clarifications: The District does not have a preference to use one manufacturer.

Roofing Design Standards Review and System Proposals - 6.0 Conclusions - Page 5

Based on the preceding, we would propose consideration of the following torch-applied systems for inclusion in BCPS Roofing Standards:

1. Siplast “Paradiene 20TS” interply torched to Insulcell RT cellular lightweight insulating concrete with “Paradiene 30 FR TG BW” cap sheet. (Miami-Dade NOA No. 13-1113.03). Use engineered metal perimeter blocking system as manufactured by ARBS which would be incorporated in Siplast’s 20-year NDL system warranty.
2. Firestone “MB Base” base sheet; “SBS Poly Torch Base” interply with “SBS FR Torch” cap sheet (ultra-white) over cellular lightweight insulating concrete. (FL HVHZ Approval LWC-138.) Use engineered metal blocking system as manufactured by ARBS which would be incorporated in Firestone’s 20-year NDL system warranty.
3. Johns Manville “DynaBase PR” base; “DynaWeld 180S” interply; “DynaWeldCap 180FR” cap sheet over cellular lightweight insulating concrete. High reflectance cap sheet available. (Miami-Dade NOA 16-0906.08.) Use engineered metal perimeter blocking system as manufactured by ARBS which would be incorporated in J-M’s 20-year NDL system warranty.

All three manufacturers have been active in the South Florida roofing market and meet the requirements of Miami-Dade and the Florida Building Code. It is our experience that the above roof systems have performed in high wind environments and provide life-cycle performance equivalent to the Soprema system currently specified.

CBRE| Heery Responses and Clarifications: The Contractors listed can only be considered if they receive all required NOAs based on the District’s Design Standards.

Addendum to Report Page 1 of 1

1. Soprema single-source roof manufacturer: This basically eliminates some advantages of competitive bidding and requires additional scrutiny of bid costs. We would estimate that the loss of competition allows for pricing that could run about 3-5% above that in a truly competitive bid scenario. That equates to \$30-\$50,000 in a \$1M project.

CBRE| Heery Responses and Clarifications: Soprema is not the District’s single source roofing manufacturer, however, Soprema is the only manufacturer that has an NOA that complies with the District’s Design Standards. In addition, Soprema was the only manufacturer that tested the entire roof assembly process, however, there is now a new manufacture that has completely tested the process and is currently submitting to obtain a NOA.

Roofing Design Standards Review and System Proposals

Broward County Public Schools

Ft. Lauderdale, FL

May 12, 2020

Terracon Project No. F9206080

Prepared for:
CBRE/Heery
Atlanta, GA

Prepared by:
Terracon Consultants, Inc.

Offices Nationwide
Employee-Owned

Established in 1965
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Terracon

Geotechnical ■ Environmental ■ Construction Materials ■ Facilities



May 12, 2020

CBRE/Heery
3550 Lenox Road
Suite 2300
Atlanta, GA 30326

Attn: Mr. Glenn M. Jardine, P.E.
Executive Managing Director
O: 404.946.2150
M: 678.641.9352
Email: glenn.jardine@cbre.com

Re: Roofing Design Standards Review and System Proposals
Broward County Public Schools
Ft. Lauderdale, FL
Terracon Project Number: F9206080

Dear Mr. Jardine:

Terracon Consultants, Inc. (Terracon) is herein submitting our Roofing Design Standards Review report. This review was authorized by CBRE/Heery via Proposal No. PF9206080 dated March 27, 2020. This report presents our findings, analysis and recommendations for roofing systems which are equivalent to the systems listed in the standards.

We appreciate the opportunity to provide service to you on this project. If you have any questions concerning this report, or if we may be of further service, please contact us.

Sincerely,

Terracon Consultants, Inc.

A handwritten signature in blue ink, appearing to read "James E. Saizan".

James E. Saizan, R.A., RRC
Senior Project Architect
Facilities Services

A handwritten signature in blue ink, appearing to read "Brian J. DuChene".

Brian J. DuChene, P.E.
Principal
Facilities Services

1.0 PROJECT BACKGROUND

Terracon has been commissioned by CBRE/Heery to review and evaluate existing Broward County Public Schools (BCPS) Roofing Design Standards with respect to approved modified bitumen roofing systems and manufacturers. The purpose of this review was to identify specific requirements, analyze criteria and identify roofing systems which meet the criteria and provide equivalent performance to the roofing manufacturers listed in the Design Standards.

2.0 SCOPE OF SERVICES

Our scope of services included:

- § Review of the BCPS Roofing Design and Material Standards and Specifications.
- § Review the 2017 Florida Building Code and State Requirements for Educational Facilities (SREF) to evaluate which BCPS standards are Code or preferences.
- § Evaluate the preferences (such as wind rider warranties) and provide an estimate of the cost increases for preferences or options. Consult with roofing manufacturers to obtain cost impact information.
- § Identify up to three approved manufacturers and specific systems which are able to provide roofing systems that comply with BCPS Standards.
- § Provide analysis and recommendations for CBRE/Heery and BCPS.

3.0 OVERVIEW OF BCPS ROOFING STANDARDS

3.1 Referenced Standards

The standards for roofing system performance referenced in the BCPS Roofing Standards are:

- § Florida Building Code (current edition 2017) and the Roofing Application and Test Application Standards (RAS and TAS) therein
- § Miami-Dade Test Protocols
- § ASCE 7 (for wind load design)
- § Factory Mutual Research Corporation (FM Global)
- § Underwriters Laboratories (UL)
- § National Roofing Contractors Association (NRCA)
- § Sheet Metal and Air Conditioning Contractors Nation Association (SMACNA)

For the purposes of testing and approvals, acceptance by the Florida Building Code (FBC Product Approvals) or Miami-Dade are critical for system approval.

3.2 BCPS Standards Review

The BCPS roofing standards permit bituminous roofing systems on school facilities. Our focus for this evaluation was on the modified bitumen roof system specification. Our understanding is that there is a preference within the District for one manufacturer (Soprema) of modified bitumen membranes. The modified bitumen specification does indicate a specific Soprema system, but also lists an equivalent GAF system, and references Garland and Tremco as equivalent manufacturers without specifying products by those manufacturers.

As for modified bitumen standards, BCPS specifications indicate preference for torch-applied systems, with hot asphalt mopping application only as specially allowed. The system makeup is referred to as a base plus 2-ply SBS, with top ply being a granule-surfaced cap sheet. Substrate may consist of lightweight insulating concrete or rigid foam insulation over steel deck. Membrane sheet reinforcement is specified as polyester.

The specification also refers to use of high-reflectance surfacing to meet “cool roof” standards. This particular requirement is stipulated in the 2017 Florida Energy Conservation Code and is therefore a code requirement.

3.3 Overview of Code, SREF and Miami-Dade Schools Standards

The 2017 Florida Building Code has specific sections devoted to design of structures in the High Velocity Hurricane Zone (HVHZ). In particular, roofing test application standards (TAS) are indicated as HVHZ specific. Broward County is in the HVHZ. TAS 110 and 114 refer to roofing systems and refer to a wide variety of low-slope and steep-slope roofing systems. For each system, applicable ASTM standards are listed.

In Chapter 15, Roof Assemblies and Rooftop Structures, Section 1519 addresses low-slope roofing in the HVHZ and references bituminous membranes only. These include BUR and modified bitumen assemblies. Although single-ply roof membranes comply with FBC material and installation requirements in general, the HVHZ requirements are more stringent as to which low-slope systems are allowed.

The State Requirements for Educational Facilities (SREF, 2014 edition) does not specify roofing system requirements beyond those allowed under the FBC. Our own experience with other school districts indicates a wider variety of roof systems in use, such as adhered single-ply membranes. This would appear to allow some flexibility for individual school districts to create their own standards within what the Code allows (i.e. preferences).

With respect to this, we were provided with a copy of the Miami-Dade Schools Roofing Standards in order to compare what this adjacent HVHZ district allows. They allow three roofing manufacturers: Soprema, Siplast and Firestone. As in Broward, a base and two-ply SBS membrane is permitted, including a high-reflectance cap sheet. The systems specified in the Miami-Dade Schools Roofing Standards are preferences, likely because of performance track record, good technical representation and good warranty coverage. Also, all 3 have assembly or component approvals by Miami-Dade.

4.0 EQUIVALENT SYSTEMS

We evaluated torch-applied roofing systems by Soprema and other manufacturers, as well as those already approved for use in BCPS and Miami-Dade. A comparison of systems is provided below:

Manufacturer	Cap Sheet	Thickness (mils)	High SRI	Interply Sheet	Reinforcement	Miami-Dade or FL Approval
Soprema	Sopralene Flam 180 FR GR	157	Yes	Sopralene 180 Sanded	Polyester	Yes
GAF	Ruberoid Energy Cap SBS 30 FR	165	Yes	Ruberoid SBS HW Smooth	Polyester	Yes
Garland	Stress Ply E FR Mineral	160	Yes	Stress Ply E	Polyester & Fiberglass	Yes
Tremco	Powerply SBS Deluxe HW	140	Yes	Powerply SBS Base HW	Fiberglass	Not Shown
Firestone	SBS FR Torch	160	Yes	SBS Poly Torch Base	Polyester & Fiberglass	Yes
Johns Manville	DynaWeldCap 180 FR	157	Yes	DynaWeld 180S	Polyester & Fiberglass	Yes
Siplast	Paradiene 30 FR TG BW	138	Yes	Paradiene 20 TS	Fiberglass	Yes

The roofing manufacturers above all compete in the commercial roofing market in South Florida and elsewhere in the region. Garland and Tremco are different in that they both offer complete design-build services. From that standpoint, traditional design-bid-build procurement would likely exclude those manufacturers.

5.0 SYSTEM COMPARISON CRITERIA

For the comparison criteria, we have listed the following:

- § Reinforcement: Polyester reinforcement is considered superior in puncture resistance, and fiberglass is more dimensionally stable. When combining both types of reinforcement in a cap sheet, we would look at ASTM test results for tear resistance and compare it to the Soprema system.
- § Cap Sheet thickness: Another criterion in durability is the thickness of the cap sheet. Of all the products shown, the polyester and combination reinforced sheets are all in the same range (157 to 165 mils).
- § Windspeed Rider: One major criterion reviewed is the Windspeed rider on the roofing manufacturer's warranty. In general, a Windspeed rider is widely endorsed in the industry and documents a manufacturer's acceptance of wind speeds in excess of warranty-standard gale force winds. This rider is most commonly written for wind speeds of 120 to 140 mph. Soprema currently offers a 180-mph wind speed rider for BCPS projects to match the 180-mph design wind speed for Risk Category III (school) facilities.

Analysis of Criteria

The Soprema and GAF systems meet all of the BCPS requirements regarding sheet reinforcement and high-reflectance of cap sheet. As noted previously, the use of polyester as a reinforcement mat delivers better puncture resistance, which is a plus in a windborne debris zone such as Broward County.

Our opinion is that other commercial-grade systems will deliver similar performance and should be considered. Reinforcement mats are proprietary and difficult to compare on an "apples-to-apples" basis. Therefore, we compared the tested ASTM values for tear strength performance of the cap sheets. The tear strength test values on products with combination or other reinforcement vary widely, but three systems are comparable to the Soprema product. Those are Johns Manville, Siplast and Firestone.

Regarding the Windspeed rider, it should be noted that this rider is not intended to meet the ultimate wind speed; rather it is defined to meet the equivalent basic wind speed as defined in ASCE 7. For an ultimate wind speed of 180 mph, the basic wind speed equivalent is 139 mph.

There are also exclusions within the rider (and the warranty) which would provide a manufacturer with various reasons to invalidate a warranty or deny a claim. In the event of a catastrophic event (a major hurricane), excessive wind gusts, windborne debris and tornadic (microburst) events would nullify a warranty. Also, roof failure may be caused by inadequate structure and deck assembly and the resulting collapse or excessive deflection is a reason for invalidation.

In sum, in a severe wind event with major loss of roofing, a warranty will not guarantee compensation for loss. Engineering and design become critical in this environment and are the best defense against system failure.

6.0 CONCLUSIONS

Based on the preceding, we would propose consideration of the following torch-applied systems for inclusion in BCPS Roofing Standards:

1. Siplast “Paradiene 20TS” interply torched to Insulcell RT cellular lightweight insulating concrete with “Paradiene 30 FR TG BW” cap sheet. (Miami-Dade NOA No. 13-1113.03). Use engineered metal perimeter blocking system as manufactured by ARBS which would be incorporated in Siplast’s 20-year NDL system warranty.
2. Firestone “MB Base” base sheet; “SBS Poly Torch Base” interply with “SBS FR Torch” cap sheet (ultra-white) over cellular lightweight insulating concrete. (FL HVHZ Approval LWC-138.) Use engineered metal blocking system as manufactured by ARBS which would be incorporated in Firestone’s 20-year NDL system warranty.
3. Johns Manville “DynaBase PR” base; “DynaWeld 180S” interply; “DynaWeldCap 180FR” cap sheet over cellular lightweight insulating concrete. High reflectance cap sheet available. (Miami-Dade NOA 16-0906.08.) Use engineered metal perimeter blocking system as manufactured by ARBS which would be incorporated in J-M’s 20-year NDL system warranty.

All three manufacturers have been active in the South Florida roofing market and meet the requirements of Miami-Dade and the Florida Building Code. It is our experience that the above roof systems have performed in high wind environments and provide life-cycle performance equivalent to the Soprema system currently specified.

7.0 LIMITATIONS

The analysis and opinions presented in this report are based upon the information provided to us by roofing manufacturers and published standards. These analyses and opinions do not consider any other aspects of decision-making by BCPS regarding qualification of manufacturers. We acknowledge that manufacturer preferences are the prerogative of any public entity to ensure the interests of users and the public are protected.

This report has been prepared for the exclusive use of CBRE/Heery and Broward County Public Schools for specific application to the project discussed and has been prepared in accordance with generally accepted engineering practices. No warranties, either expressed or implied, are intended or made. In the event that information described in this document which others provided is incorrect, or if additional information becomes available, the conclusions and recommendations contained in this report shall not be considered valid unless Terracon reviews the information and either verifies or modifies the conclusions of this report in writing.

ADDENDUM TO REPORT

Roofing Design Standards Review and System Proposals

Broward County Public Schools

COST IMPACT OF PREFERENCES

June 5, 2020

Terracon's report of May 12, 2020 identifies aspects of the Design Standards which are preferences, and not specifically code requirements. Cost impacts of those preferences are as follows:

1. Soprema single-source roof manufacturer: This basically eliminates some advantages of competitive bidding and requires additional scrutiny of bid costs. We would estimate that the loss of competition allows for pricing that could run about 3-5% above that in a truly competitive bid scenario. That equates to \$30-\$50,000 in a \$1M project.
2. Torch-applied membrane: There are advantages to this installation method. Even though the material cost may be slightly higher (5%) than typical mop-grade sheet, deleting the hot bitumen kettle and all of the associated safety, air quality, logistics and quality control measures and reduced labor costs more than compensate for that. Overall, we estimate a savings of 5-10% by using torch application.
3. Polyester sheet: The advantage mentioned previously is the better puncture resistance in a windborne debris zone. Polyester sheets are available with thicker scrims if preferred. Overall, a cost increase using polyester vs. fiberglass or hybrid reinforcement of average \$0.25/SF (or 10%). The more significant impact is that this preference limits the number of qualifying manufacturers to Soprema and GAF.
4. Wind Speed Rider: The cost difference was quoted as a few hundred to a few thousand dollars. Historically, this warranty rider has been provided by some manufacturers free of charge, but recent trends show nominal upcharge for the administrative costs to producer the rider. Overall cost increase about 1% or less on average.
5. Lightweight Concrete Substrate: The cost advantage of lightweight concrete vs. rigid board insulation is a savings of 10-20% on a large open roof. The break-even point is historically about 10,000 SF where the lightweight on smaller roofs is more costly than rigid board due to staging costs.

As for other factors (reflective cap sheet, bituminous membrane), those are defined as code requirements specific to the Florida Energy Conservation Code and Florida Building Code High Velocity Hurricane Zone requirements.