Concrete Pavement Joint and Crack Sealing

Market Trends, Current Research and Best Practices

Presented by Seal/No Seal Group
Introduction

- John H. Roberts - Executive Director, International Grooving and Grinding Association
- Scott Eilken – Quality Saw and Seal, Co-Chairman of Seal/No Seal Group
- Charley Grady – Crafco Inc., Co-Chairman of Seal/No Seal Group
- Kari Moosmann – Constructive Communications Inc.
Presentation Outline

- Market trends and issues affecting the joint and crack sealing marketplace
- SNS Group origin, organization and Mission
- SNS Group activities and initiatives
  - TTI research effort
  - Development of new methods to test cleanliness, dryness, and adhesion
  - Backer rod manufacture and use
- SNS group communications and media efforts
- 2012 Opportunities
- Proper joint sealant installation techniques
- Questions and Answers
- IGGA Hospitality Suite!!!!!!
Marketplace Trends and Key Issues

- Conflicting information regarding sealant effectiveness and performance
- Focus is initial construction costs and not long term value of sealant
- Joint associated distress issues are becoming more prevalent—What is the cause?
- Proper construction and inspection
- Development of better test procedures
- Defining when to reseal
Is Sealing Joints Cost Effective?

- Multiple sealant test sections have been constructed across the USA by State Departments of Transportation.
- The FHWA engages in several research initiatives in an effort to determine sealant cost effectiveness.
- AASHTO undertakes development of new pavement design guide (MEPDG) where sealant effectiveness is considered.
The Experts Don’t Agree!

FHWA Sealant Effectiveness Study

Performance of Sealed and Unsealed Concrete Pavement Joints

This Tech Brief presents the results of a nationwide study of the effects of transverse joint sealing on performance of jointed plain concrete pavement (JPCP). This study was conducted to assess whether JPCP designs with unsealed transverse joints performed differently from JPCP designs with sealed transverse joints. Data and deflection data were collected from 117 test sections at 34 experimental joint sealing projects located in 11 states. Performance of the pavement test sections with unsealed joints was compared with the performance of pavement test sections with one or more type of seal joint.

BACKGROUND

The sealing of transverse concrete joints in JPCP has been standard practice throughout much of the United States for many years. Its widespread use is due to the common belief that sealing joints improves concrete pavement performance in two ways: by reducing water infiltration into the pavement structure, thereby reducing the occurrence of moisture-related distresses such as spalling and scaling, and by preventing the infiltration of incompatible (e.g., sand and water) materials into the joints, thereby reducing the likelihood of joint-related distresses such as joint spalling and blowouts.

The joints in jointed concrete pavement (JCP) are typically created by making an initial saw cut to form controlled cracking, followed by a second, wider saw cut to produce a reservoir for the joint sealant material. This traditional approach of sawing and sealing transverse construction joints is estimated to account for between 2 and 7 percent of the initial construction cost of a JCP. Moreover, these sealed transverse joints require resetting one or more times over the service life of the pavement, leading to additional costs in terms of labor, materials, operations, and lane closures.

Recently, several state departments of transportation (DOTs) have been questioning conventional transverse joint sawing and sealing practices. These agencies contend that the benefits derived from sealing do not offset the costs associated with the placement and continued upkeep of the sealant over the life of the pavement. As a result, they have been experimenting with different sawing and sealing alternatives, for example:

- Narrow unsealed joints, consisting of single saw cuts that are left unsealed.
- Narrow filled joints, consisting of single saw cuts that are filled with sealant that adheres to the sides and bottom of the saw cut.
- Narrow sealed joints, consisting of single saw cuts that contain a narrow backup rod and sealant material.

AASHTO Pavement Design Guide

NO YES
What Is the Compelling Issue?

- As cost pressures continue, there is increased interest in eliminating joint sealants as a means of lowering the cost of concrete pavements. However, there is a lack of data in the industry to help guide owners about sealant effectiveness and the long-term impact of using or not using such sealants.

  - Alternate Bid Projects (AC versus Concrete)
  - Concerns for Low Initial Cost Due to Budget
Defining Sealant Life - CALTRANS

Table 2: Crack Sealer and Filler Specifications

<table>
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<tr>
<th>Material</th>
<th>Specifications (CT/AASHTO)</th>
<th>Application Type</th>
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Defining Sealant Life - FHWA

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*Times greater than 82 months are extrapolated to a maximum of 200 months.*
Our Customers Disagree—Who is Correct?

Crafco 221 = 5.4 – 9.8 yrs
Crafco 231 = 6.4 – 9.5 yrs
Dow 888 SL = 12.8 yrs
Dow 888 = 13.9 yrs

232% to 348% Increase for Silicone
New Challenges For the Industry
Joint Associated Distress (JAD)
Joint Associated Distress - Bottom up
Joint Associated Distress - Bottom up
Common Joint Associated Distress Types

- Damage in top third
- Damage below the saw-cut
- Damage from the bottom
- Full depth damage
Distress From Curb Out - JAD
Parking Lots Affected Also - JAD
Interim Guide Specifications

Initial Culprit...

Joint sealant and backer rod!
Investigative Questions Regarding JAD

- Does salting increase or decrease the number of freeze thaw cycles?
- What are the temperatures in a slab?
- Construction traffic loading?
- Can we reproduce this in the lab?
- What can we learn from the field?
Ponding of Water In Pavement - JAD
Distress Below Sealant - JAD
Investigative Cores - JAD
Mortar Distress - JAD
Sealant Durability Despite JAD
Could early loading be adding to the problem?
State DOT Survey Related to JAD

- States that provided detailed response:
  - Iowa (transverse and longitudinal)
    - 15 years – major distress
  - Minnesota (transverse, 2 instances)
    - 13 years – major distress
  - Michigan (transverse and longitudinal, 4 instances)
    - 6 years – staining
  - Indiana (primarily longitudinal, 3 instances)
    - 9 years – some deterioration

Max Prokudin
Purdue Work on JAD

- Damage depends on saturation
- Saturation depends on air content in the concrete and water/cement ratio of the concrete
- Some salts prevent drying
Joint Associated Distress - Guidelines
Environmental Issues (e.g. Illinois)

“The general contractor is required to hire an environmental firm with at least five (5) documented leaking underground storage tank (Lust) cleanups or that is prequalified in hazardous waste by the Department to remediate the soil contamination and monitor for worker protection”

This ties back to TTI Research funded by the SNS Group!
To address the question of the effect of joint sealing on JCP performance, the FHWA sponsored a study to collect and examine field performance data from a wide variety of in-service concrete pavement joint sealing experiments across the United States. This TechBrief presents the results of this nationwide study.
Purpose of the Study

“This TechBrief presents the results of a nationwide study of the effects of transverse joint sealing on performance of jointed plain concrete pavement (JPCP). This study was conducted to assess whether JPCP designs with unsealed transverse joints performed differently from JPCP designs with sealed transverse joints. Distress and deflection data were collected from 117 test sections at 26 experimental joint sealing projects located in 11 states. Performance of the pavement test sections with unsealed joints was compared with the performance of pavement test sections with one or more types of sealed joints.”
Sealant Study Site Locations

Figure 1. Location of joint sealing experimental sites.
The presence or absence of dowels in the transverse joints was far more important a factor in joint faulting than whether the joints were sealed or unsealed.

The faulting in some sealed-joint sections were slightly higher than the faulting in the unsealed section.

The data detected no significant difference between average joint faulting in the sections sealed with the average joint faulting in the corresponding unsealed test sections.
Sealant Study Preliminary Findings

- The narrow width of unsealed joints (usually single sawcut) limited the infiltration of coarse incompressibles to a degree comparable to that of any of the three types of sealed joints.
- Slab edge support tended to be either adequate or inadequate regardless of joint sealing treatment, which suggests that the joint sealing treatment has a fairly minor influence, if any, on the quality of slab support.
Industry Concerns With Findings

Since the average age of the sections evaluated in this study is approximately 12 years, the findings represent performance based on typical mid-term service lives for dowelled concrete pavements; particularly those located in wet-freeze environments.
Industry Concerns With Findings

- When interpreting the findings, the limitations of the study should be considered. As indicated previously, the age of the test sections does not permit a complete analysis of the long term effects. Additionally, the results are most applicable to dowelled pavements in the wet freeze environment.
Seal/No Seal Group is Formed

The joint sealing industry could no longer survive without dedicated, 
**membership driven** representation at the national level!

The **Seal/No Seal Group** was formed to respond to the challenges, bias and misinformation facing this vital industry.
SNS Group – Mission

The SNS Group’s Mission is to develop a committed membership that takes responsibility for determining the long-term effectiveness of sealants in concrete pavements.
SNS Group – Initial Charter

- Develop membership base and funding mechanisms
- Promote, develop and monitor test section construction
- Promote, fund and conduct sealant research
- Prepare Updates and Tech Briefs on findings and relevant information
Current Sponsors
How SNS Group is Organized

Management Group
- Scott Eilken
- Charlie Grady
- John Roberts
- Matt Ross

Technical Committee
- Mike Darter
- Dan Zollinger
- Katie Hall
- Wouter Gulden
- Imad Al Qadi
- Robert Rodden
- Larry Scofield
SNS Early Successes

- Developed committed membership base
- Enlisted a consultant (SME) to re-evaluate 58 of the 93 FHWA sealant sections
- Established and maintain SNS website
- Constructed 10 new sealant test section’s
- Provided numerous presentations to Specifiers and industry partners
- Invited to speak at powerful TRB Sealant Committee Meeting in DC
- Consistent media exposure (Better Roads, Roads and Bridges, Pavement Pres Journal)
SNS 2011 Activities

- Sponsor sealant research with TTI
- Work with Caltrans on sealant strategy
- Fund WJE research on Clean, Dry, Sticky
- Develop *Sealant Specifications for General Use*
- Respond and contribute to NCPTC Joint Deterioration Research effort.
SNS 2011 Activities

- Promote ACPA’s Joint Noise Estimator
- Participate on ACPA’s Jointing task force
- Canvass Agencies for experience on blow ups and abutment encroachments
- Conduct backer rod absorption research
- Promote quality sealant installation
- Develop and distribute Tech Briefs
Texas Transportation Institute Study
Who is TTI?

- Texas Transportation Institute
- A member of the Texas A&M University System
- Established in 1950
- Annual research budget $50 million
- TTI is recognized as one of the finest higher education-affiliated transportation research agencies in the nation and helps prepare students for transportation careers.
TTI Test Plan

- Project initiated in 200?
- Project cost $35,000
- Completion in 2012
- Measure flow through sealed, partially sealed and unsealed joints
- Develop infiltration test procedures
- Develop Ground Penetrating Radar test procedures
- Project funded by industry contributions to the SNS Group
Laboratory Joint Opening Device
Field Movable Joint Opening Device

Movable Slab
Field Movable Slab Locations
California DOT (Caltrans)

- Started with Caltrans involvement June 2010
- Field review August 24/25 in So Cal
- Follow on meeting January 10, 2011
- Developed Proposed Sealant Evaluation Test Plan for Caltrans Consideration April 1, 2011
- Final Product is a universal Test Section Plan
Joint Reservoir Moisture and Contamination Test Procedure Development

- Research conducted by Wiss Janney Elstner (WJE), Glenview Illinois
- Established 1956
- Project initiated 2010
- Project budget $6,000
- Completion 2012
- Funded through industry contributions to the SNS Group
WJE Study (Clean, Dry, and Sticky)

- **Contamination (Clean & Sticky)**
  - Tape Contamination and Wipe Test
  - Tape Adhesion Bond Strength Pull Test
  - UV Light Inspection

- **Moisture Content (Dry)**
  - Moisture Paper
  - Resistivity Meter
  - Relative Humidity Gauge
  - Electromagnetic Moisture Meter
Cast and Sawn Samples
Moisture Tests

Relative Humidity Probe

AC Resistance

Moisture Paper
Contamination Tests
## WJE Research Results – Cleanliness Test

### TEST METHOD: Tape Contamination Test (Cleanliness)

**STANDARD REFERENCES:** Section 5.4 and 8 of SSPC-SP 13/NACE No. 6.

**USAGE:** Measure of the cleanliness of the prepared concrete joint prior to application of joint sealant.

**EQUIPMENT / MATERIALS:**
1. 3/4 inch wide black electrical tape
2. Tongue depressor or other flat tool made of wood, metal, or stiff plastic. Length of the depressor should be sufficiently long to extend to the bottom of the cut joint with room to hold it above the surface of the concrete.

**PROCEDURE:**
1. Cut a strip of black tape. The length of the strip should be at minimum two times the depth of the joint plus two (2) inches.
2. Wrap the tape around the depressor with the adhesive side of the tape facing away from the depressor.
3. Insert the tape and depressor into the joint, perpendicular to the surface of the concrete slab/pavement.
4. Firmly rub the tape against the surface of the joint with the tongue depressor. Rub both vertical surfaces and the bottom of the joint. Sufficient pressure should be applied so the level of contaminant removal is not affected by slight variations in pressure.
5. Remove the depressor and tape.
6. Examine the tape for contaminants. Grade level of contaminants per the visual standard.
7. Repeat the procedure at one additional location within 12 inches of the first test.
8. Report the contamination level of the two tests and determine if the level of contamination is below the predetermined acceptance threshold. (If applicable).

**REPORT:**
1. Sawout width and preparation method
2. Time and date of the test
3. Test location
4. Length of sawout joint represented by the test
5. Test result of the two tests by visual standard level (Trace, Light, Moderate, Heavy).

### VISUAL STANDARD

**TRACE**

**LIGHT**

**MODERATE**

**HEAVY**
Draft Test Method V. 1.0 (January 2012)

Test Method: Moisture Sensitive Paper (Moisture)

Standard References: None

Usage: Test to determine the presence of moisture in concrete joints prior to applying sealant.

Equipment/Materials:
1. One-time use moisture sensitive paper (Hydrom water finding test paper, CAT#WF-130, Micro Essential Laboratory, Inc., Brooklyn NY, or equal).
2. Tongue depressor or other flat tool made of wood, metal, or stiff plastic. Length of the depressor should be sufficiently long to extend to the bottom of the cut joint with room to hold it above the surface of the concrete.

Procedure:
1. Cut the moisture sensitive paper into strips. The length of the strips should be at minimum twice the depth of the joint plus two inches.
2. Place the moisture sensitive paper strip around the tongue depressor and insert into the joint, perpendicular to the surface of the concrete slab/pavement.
3. Press the paper against the surface of the joint with the tongue depressor. Press against both vertical surfaces and the bottom of the joint. Hold paper down against each surface for 10 seconds.
4. Remove the depressor and tape. Examine if the tape indicated significant moisture. Grade moisture per the visual standard.
5. Repeat the procedure at one additional location within 12 inches of the first test.
6. Report the highest moisture level of the two tests and determine if moisture content is below the predetermined acceptance threshold (if applicable).

Report:
1. Sawcut width and preparation method
2. Time and date of the test
3. Test location
4. Length of sawcut joint represented by the test
5. Test results of the two tests by visual standard level (None, Light, Moderate, Heavy).

Comments can be directed to Paul Krauss at Wiss, Janney Elstner Assoc., 847-753-5617, pkrauss@wja.com
WJE Research Results – WipeTest

DRAFT TEST METHOD v. 1.0 (January 2012)

TEST METHOD: Wipe Test (Cleanliness)

STANDARD REFERENCES: Section 5.4 and 6 of SSPE-SP 13/NACE No. C-ASTM D 5295

USAGE: Measure of the cleanliness of the prepared concrete joint prior to application of joint sealant.

EQUIPMENT / MATERIALS:
1. Black 100% cotton cloth
2. Tongue depressor or other flat tool made of wood, metal, or stiff plastic. Length of the depressor should be sufficiently long to extend to the bottom of the cut joint with room to hold it above the surface of the concrete.

PROCEDURE:
1. Cut the cloth into 2-inch wide strips. The length of the cloth strips should be at minimum two times the depth of the joint plus two inches.
2. Place the cloth strip around the tongue depressor and insert into the joint, perpendicular to the surface of the concrete slab or pavement.
3. Firmly rub the entire width of the cloth against the surface of the joint with the tongue depressor over a 2 in. length of the joint. Rub both vertical surfaces and the bottom of the joint. Sufficient pressure should be applied so the level of contaminant removal is not affected by slight variations in pressure.
4. Remove the depressor and cloth. Use caution when handling the cloth to avoid dislodging contaminants by shaking the cloth.
5. Examine the cloth for contaminants. Grade contamination per the visual standard.
6. Repeat the procedure at one additional location within 12 inches of the first test.
7. Repeat the contamination level of the two tests and determine if the level of contamination is below the predetermined acceptance threshold (if applicable).

REPORT:
1. Sawcut width and preparation method
2. Time and date of the test
3. Test location
4. Length of sawcut joint represented by the test
5. Test results of the two tests by visual standard level (None, Light, Moderate, Heavy).

COMMENTS CAN BE DIRECTED TO PAUL KRAUS at WJE, Janney Eisenhart Assoc., 847-733-8537, pkraus@wje.com
Interim Guide Specifications

Initial Culprit...

Joint sealant and backer rod!
Pavement Joint Noise Estimator

Unsealed vs Sealed Joint is about 5 dBA
ACPA Jointing Task Force

- Formed to address joint related issues including seal/no seal
- Comprised of private and public sector participants
- Co Chairman Scott Eilken of SNS Group
- Results will be used to develop industry policy and positions
Backer Rod Usage Research

- Investigated 4 different types of rod
- Identified proper applications for each
- Identified use patterns by contractors in the field
Backer Rod Usage Research

- Four types of backer rod identified; closed cell, open cell, cross-linked closed cell and bi-cellular rod.
- All types compatible with cold applied sealants.
- Due to their ability to absorb moisture, open cell rod should not be used in PCCP applications.
- Closed-cell backer rod does not absorb water and is essentially water proof.
- Closed-cell backer rod is only suitable for cold-applied sealants unless the polyethylene has been cross-linked.
Backer Rod Usage Research

- Closed-cell backer rod is only suitable for cold-applied sealants unless the polyethylene has been cross-linked.
- Open cell rod is being used inappropriately in some PCC paving situations and can be attributed to a number of premature sealant failures in the field and may be responsible for some premature joint associated distresses.
- This misuse of open cell rod is contributing to the negative sealant perceptions in the field and loss of market share for the industry!
Promote Proper Sealant Installation
Joint Preparation and Cleanliness

- Joint preparation and cleanliness is the least costly procedure related to joint and crack sealing yet it is often the most underapplied and omitted part of the process.

- This has let to a very negative perception regarding sealant life and effectiveness!
Percent of Total Cost For Each Operation of Sealing a Joint

- Furnish and Install
- Cleaning
- Reservoir Cut
- Initial Cut

Operations:
- Non Sag Silicone
- Self Leveling...
- Hot Pour
- Compression
Communications and Media Efforts

- Kari Moosmann
  AEC Editorial Manager
  Constructive Communication Inc.
Communication and Media Efforts

- Tech Briefs
- Sealant Field Evaluation Reports
- Joint Associated Distress Reports
- Media Placements
- Web Site
Tech Briefs

Use of Silanes for Sealing Joints in Concrete Pavements

Introduction
Traditional sealing of expansion jointing is performed using bitumen-based materials. These materials, however, are prone to failure due to environmental conditions and traffic-induced distress. The commercial availability of silanes provides an alternative to traditional sealants due to their superior performance characteristics.

Silanes are non-toxic, low-maintenance materials that offer long-term durability. They are effective in sealing joints against moisture, dust, and mechanical forces. This makes them ideal for use in pavements with high traffic volumes and in areas prone to severe weather conditions.

Concrete Sealers
Concrete sealers have been used in the construction industry for several decades. They are applied to joints to prevent water penetration and to reduce the risk of concrete deterioration.

Silane-based sealers have several advantages over traditional sealers. They are more resistant to temperature changes and are less susceptible to deformation under traffic loads. Additionally, silane-based sealers are eco-friendly and have a reduced environmental impact.

North Carolina DOT used the concrete sealers at the Jefferson National Memorial Foundation parking lot. They reported significant improvements in joint performance, including a reduction in water penetration and an increase in overall pavement life.

Joint Movement Estimator for Designing Transverse Joint Configurations

Introduction
Joint movement is a critical factor in the design of pavements, as it affects the performance and longevity of the pavement. Accurate estimation of joint movement is essential for ensuring the structural integrity and durability of the pavement.

The Joint Movement Estimator (JME) is a tool designed to help engineers determine the optimal joint configuration for pavements. It takes into account factors such as traffic volume, load distribution, and climate conditions to predict joint movement accurately.

The JME incorporates a detailed analysis of the materials used in the pavement, including the properties of the concrete and the joint sealant. This information is used to simulate the behavior of the pavement under various loading conditions.

The estimator provides a range of joint movement predictions for different designs. This information is crucial for selecting the most suitable joint configuration that will withstand the expected loads and weather conditions.

Conclusion
The use of silanes for sealing joints in concrete pavements offers several advantages over traditional sealing materials. They are more resistant to environmental factors and provide long-term durability. The Joint Movement Estimator is a valuable tool for designing pavements that can withstand the expected loads and weather conditions.

ACKNOWLEDGEMENTS
The authors would like to thank the North Carolina DOT for their cooperation and support in the testing and implementation of the new joint sealing methods.
Field Sealant Investigations
Joint Associated Distress Review
Miscellaneous Reports
The Seal/No Seal Group was formed to respond to the age-old industry question about the value of sealing concrete pavement joints. Its mission is to develop a committed membership that takes responsibility for determining the long-term effectiveness of sealants in concrete pavements.

As cost pressures continue, there is increased interest in eliminating transverse joint sealants as a means of lowering the cost of concrete pavements. However, there is a lack of data in the industry to help guide owners about sealant effectiveness and the long-term impact of using or not using such sealants.

To learn more about the current research, click on the News & Resources tab. To join the effort, click on the About Us tab.

- Seal No Seal Progress Update

"Our role is to gather the necessary information to help owners make informed decisions that will ensure long-term effectiveness and best use of their concrete pavements."

Group Co-Chair Scott L. Eilken, owner of Quality Saw & Seal of Bridgeview, Ill.

Shown here is the hot pour sealing of the control joints on the test sections for a project in Joliet, Ill. The project involved sealing the transverse and longitudinal joints, including the curb joint, with hot pour sealant.
2012 Opportunities

- Pursue evidence on damage done by incompressibles
- SPS-2 P2 Experiment
- Development of National P2 Test Bed
- GPR activities
- Field verification of WJE and TTI studies
- Enlist Petrographer to develop independent perspective of Joint Associated Distress cause(s)
Evidence of Damage due to Incompressibles

- Joint deterioration and increased maintenance
- Blow ups
- Slab Growth Abutment movement
SPS 2 Pavement Preservation Project

- SPS-2 is the largest and most comprehensive ongoing concrete experiment in the US
- Dedicated and consistent evaluation and analysis procedures
- An opportunity to leverage an existing experiment for industry benefit
National Pavement Preservation Test Bed

- Potential national Pooled Fund Study
- Leverage resources and manpower
- Opportunity to bring to bear dedicated research facilities and researchers
- Opportunities to answer the unanswered questions
- Opportunities to develop new products and techniques
Ground Penetrating Radar (GPR)

- GPR technology offers unprecedented subsurface three-dimensional (3D) imaging capabilities. Subsurface material deterioration, void imaging, and precise material and geometry measurements are all accurately and efficiently carried out using this specialized device.
Frequency -196

T - Time water was added

Begin Collection

T
- Time water was added
Field Verification of TTI and WJE

**WJE Research**
- Evaluate Cleanliness and Moisture Tests on in-service projects
- Establish criteria for acceptable limits for use in construction specifications
- Develop specifications based upon limits

**TTI Research**
- Conduct Field Infiltration Tests to establish rates of selected pavements
- Use GPR to investigate the moisture levels at joints on in-service pavements—new to old
- Attempt to establish when to reseal projects based on water infiltration rates
Overview

Although necessary in most pavements, joints can be viewed as the “weak link” in pavement design and performance. Distresses often encountered in aged pavements occur only at the joints or the distress mechanisms are more severely exhibited there. The ingress of moisture drives nearly all materials-related distresses. Non-sealed joints or compromised sealants provide that access for moisture. Further, a lack of drainage from un-activated (un-cracked) joints, debris-plugged joints, and in-filled sub-base concentrates moisture and brines (from deicers) in the joints. It is highly likely in certain cases that the adjacent concrete at pavements joints becomes critically saturated – allowing freeze-thaw distress even in high quality concretes.
QUESTIONS/COMMENTS?

Thank You!

Please join us at the IGGA Hospitality Suite at the LVH from 4-6 pm today in Suite ??? XXX Tower