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# INCREASING THE QUALITY OF CONCRETE AND CONCRETE RELATED PRODUCTS

KOSOVO CLUSTER AND BUSINESS SUPPORT PROJECT



April 19, 2007

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# INCREASING THE QUALITY OF CONCRETE AND CONCRETE RELATED PRODUCTS

THIS REPORT ADDRESSES AN ASSEMENT OF THE STATE OF PORTLAND CEMENT CONCRETE AND PORTLAND CEMENT CONCRETE PRODUCTION THROUGHOUT KOSOVO. THE REPORT PRESENTS FIELD REPORTS AND RECOMMENDATIONS TO INCREASE THE DURABILITY OF PORTLAND CEMENT CONCRETE AND INCREASE THE EFFICIENCY IN PRODUCTION OF PORTLAND CEMENT CONCRETE IN AN ATTEMPT TO INCREASE THE PROPER USE OF PORTLAND CEMENT CONCRETE.

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Kosovo Cluster and Business Support project – “Increasing the Quality of Concrete and Concrete Related Products”

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# PURPOSE OF ASSIGNMENT

The purpose of the assignment was to provide technical assistance to ready mixed concrete producers regarding quality control (QC) testing based on European standards, developing new portland cement concrete mixes to meet the European standards, and introduce the use of chemical additives, specifically water reducing and air entraining admixtures. The goal is to improve the quality of concrete products, increase production, and decrease operation costs in order to expand the local market by completing the following tasks:

- Review current principles and practices of proportioning portland cement concrete mixes.
- Determine the current level of use for chemical admixtures in concrete mixes specifically the use of water reducing admixtures (used to increase strength by reducing the amount of water needed to achieve a desired consistency), air entraining admixtures (a relatively inexpensive admixture used to increase freeze/thaw durability) and superplasticizers (used to make flowable concrete).
- Use of statistical analysis to evaluate test results for fresh and hardened concrete properties and to make adjustments, based on the analysis, to concrete mix proportions to meet European standards.
- Review the needed calculations to determine concrete mix proportions to include aggregate moisture content, specific gravity of constituents, and aggregate gradations.
- Demonstrations of proper concrete testing techniques based on European standards. The demonstrations will include testing of fresh and hardened concrete.
- Virtual Concrete Laboratory demonstrations and videos on concrete sampling and test.
- Develop mix design for usage of recycled concrete and usage of wasted material.

# BACKGROUND

Many of the concrete producers in Kosovo use mix designs handed down from past employees or experience for ready mix concrete and production of concrete elements such as curbs, concrete pipes, blocks, pavement blocks, and other concrete products. The mix proportions are based on antiquated methods that result in less durable and extremely conservative concrete.

Only three concrete producers have established laboratories for the purpose of quality control/quality assurance (QC/QA) of their products. In addition there are two other independent private laboratories that provide concrete mix proportioning and concrete testing, as well as the laboratory of Pristina University. The companies that currently have working concrete laboratories are Renelual Tahir and Vellezerit e Bashkuar from Prizren and Papenburg & Adriani from Ferizaj.

In Kosovo concrete is the main construction material used to construct all types of structures, whereas precast concrete products such as pipes, blocks, pavement concrete stones, and curbs are used in the road construction industry. One of the main constraints in the road industry is the production of low quality concrete curbs and other elements which do not last more than a few years. In addition, the concrete producers are facing high operation costs due to high cement contents or use of improper aggregates/river stones. It is believed that in Kosovo there are more than 50 concrete plants in use and over 90% of those are second hand plants older than 20 years in age, some of which are former SOE concrete plants which were installed 25 years ago.

In Kosovo, the primary material used in concrete is river stones and only a few producers use manufactured (crushed) aggregates. The aim of the government of Kosovo is to protect rivers and encourage the private sector to start using crushed aggregates for concrete production. A small number of concrete producers use chemical additives but the majority of producers are not aware of the benefits obtained by using chemical additives. There is a cement factory in Kosovo that produces over 350,000 tons annually; a further 350,000 to 500,000 tons are imported. The water used for production is mainly drinking water, which depletes the limited supply of drinking water in Kosovo.

## Market Position:

In Kosovo over 800,000 tons of cement is used in an estimated 2.0 million cubic meters. The cost of concrete is estimated to be 140 to 160 million Euros. The main competition to ready mixed concrete are handmade concrete products, which are often used for housing and road construction. Road construction accounts for over 30% of the total market. Individual investors compensate with higher prices for ready mix concrete.

## Production:

Raw materials used by concrete producers are produced locally: river stone, cement from Sharrcem (south of Kosovo), and water; additives are imported from Slovenia. Concrete plants are very old and manufacturing quality varies. Taking into consideration the total capacity of these concrete plants, Kosovo currently operates at 25% or less of production capacity reflecting a glut of concrete plants in Kosovo. There are several concrete plants that are in poor working condition and therefore application of standards will force them to improve. The Kosovo Standardization Agency publicly announced the adoption of EU concrete standards which could be approved in March 2007.

In Kosovo there are over 35 producers of pre-cast concrete elements including concrete stones for pavement, blocks, curbs, concrete pipes, concrete pillars for electricity, manholes, decorative stones from concrete, etc.

## EXECUTIVE SUMMARY

Interviews, laboratory tours, and production facility (batch plant) tours were performed with KCBS personnel to assess the current local practices for proportioning portland cement concrete and to determine the methods used to proportion concrete mixes. Based on the information obtained, demonstrations and presentations were prepared and delivered as a means to transfer knowledge regarding European standards and current concrete technology with respect to chemical additives and the production of durable concrete.

Laboratory test results of fresh and hardened concrete are used to assess the consistency, and quality of concrete. In addition, results can also be used to measure the effects of adjusting concrete mix proportions. Current test methods in Kosovo are based on past Yugoslavia test methods. Although the tests are relatively easy to perform, the methods and equipment used are not standardized making it extremely difficult for the industry to track changes in materials and trends. The industry could benefit greatly by the translation and distribution of a few basic European standards.

The concrete production facilities observed are more than adequate to produce concrete meeting the European standards. All but one batch plant observed were computerized.

The quality control personnel are using concrete mix proportions, which have been handed down over time. At each company interviewed, mix proportions were based on different methods of proportioning, none of which are very accurate. The current mindset is that greater strength equates to better concrete. The concept of designing for durability seemed foreign to most participants. Very few, if any, of the concrete mixes contain chemical additives. Most of the concrete suppliers have used chemical additives in the past but only when requested by the client.

Methods currently in use to determine concrete mix proportions result in concrete with relatively high strength. Most concrete is proportioned to meet a compressive strength of 30 MPa (4,350 psi). Most of the hardened concrete tested achieved a compressive strength of over 45 MPa (6,530 psi). Compressive strength is inversely proportional to the ratio of the mass of water compared to the mass of cement (known as the water/cement ratio). Greater strength is achieved by lowering the water/cement ratio. The mixes observed have a water/cement ratio of 0.60 or higher. The concrete producers would greatly benefit by reducing the amount of cement in concrete mixes to reach a more reasonable compressive strength. Methods to achieve this were discussed with all participants and example-mixes were proportioned incorporating methods to achieve the reduced cement content. In addition, the use of water reducing, and air entraining, additives could also play an important role in reducing the cement content while maintaining quality, gaining durability, and lowering the material cost of the concrete.

# FIELD ACTIVITIES TO ACHIEVE PURPOSES

Numerous field trips were taken for the purpose of observing laboratory practices, concrete batching methods, and materials used in the production of portland cement concrete. Presentations were given and discussions held with individuals involved in the concrete industry to present European standards, to explain the methods used to establish concrete mix proportions, and to describe methods to adjust concrete mix proportions based on test results. Reports of the field trips are presented in Annex I.

# TASK FINDINGS AND RECOMMENDATIONS

## Findings:

- The concrete industry is capable of producing very sophisticated concrete if specified. All participants were aware of newer concrete technology but have not been able to apply the technology because project specifications and standards are nonexistent.
- The concrete producers observed have some knowledge of quality control (QC) testing and are performing QC testing at a relatively basic level. Test results are recorded and stored but there was no evidence that the results were being tracked so that large variations in materials could be identified.
- The primary function of the testing laboratories observed was to provide in-house quality control for the concrete producer where the lab was housed.
- Methods for tracking and storing test results using electronic spreadsheets were presented and discussed. Statistical methods of data analysis and European standards for determining required compressive strength (using average compressive strength and standard deviation of results) were presented. Since data has not been organized, performing the statistical analysis on actual data was impossible.
- The QC test methods being used were consistent from company to company. Each company performed slump testing, and made compressive strength cubes. Other tests for determining the air content and fresh unit weight (density) of concrete are not being utilized. Although the methods were somewhat consistent, the test equipment used for determining slump was different. There is a need to distribute the interpreted European standards for basic QC test methods.
- The concrete production facilities observed are modern and in good working condition. It is assumed the batch plants are capable of dispensing admixtures into the concrete during batching and mixing. If not, dispensing units are inexpensive and in the US are supplied and installed free of charge by the chemical admixture companies.
- There exists a mindset within the industry that greater strength means better concrete. The goal of several of the QC departments was to see how strong they could make their concrete. There was significant pride shown by individuals when concrete tested at a compressive strength of 60 MPa (8,700 psi).
- Durability in the US concrete industry is defined as the concrete's ability to resist the negative impacts of the environment where it is placed. As an example concrete containing no entrained air will deteriorate in an environment where there exists freezing and thawing conditions. Designing concrete for durability seemed like a new concept for the participants primarily because compressive strength is the only property specified.

Currently durability in concrete is a function of the high compressive strength. It is true that concrete strength is directly proportional to durability. Increased strength is achieved by increasing the cement content. Since cement is the most expensive constituent in concrete increasing the cement content increases the cost of the materials.

- The industry could benefit by designing concrete to achieve durability. The use of chemical additives (admixtures) would be the most cost effective way to achieve this.
- The individuals interviewed had a good working knowledge of the Yugoslavian test methods. They did however struggle with methods used to determine concrete mix proportions that differ from what they are using. The current method relies on an empirical formula used to determine the water/cement ratio. Since concrete is one of the only materials sold by volume but batched by mass, newer methods use the specific gravity (the mass of a constant volume of material as compared to the mass of the same volume of water) of each material to determine the volume/mass relationship. Although the manual used by most QC managers addresses this relationship, mix proportions are still determined based on the empirical formula.
- It is going to be difficult to convince the producers that purposely entraining air into concrete will increase the freeze/thaw durability. One producer actually puts an admixture in the concrete to remove air. There are several technical journal articles available that prove entrained air in concrete increases freeze/thaw durability. These types of materials would be a benefit if they could be translated. In addition testing could also help in convincing producers of the benefits of air entraining admixtures.
- The benefits of using water-reducing admixtures will be easier for the producer to accept since one can see the benefits immediately. The main benefit is reducing the amount of water needed, which will increase the compressive strength for a given mass of cement. The supplier can then reduce the amount of cement to achieve the same strength gained prior to the use of the water reducer.
- Discussions were held with a local architect to determine how concrete is specified for projects. Currently, concrete compressive strength is the only property specified. Concrete construction in general could also benefit by educating the design professionals on new concrete technologies.
- The cooperation within the industry is impressive. Numerous times competing QC managers would share information help each other by explaining their understanding of the concepts presented.
- There exists a concrete technical committee within the Road Construction Association of Kosovo. The committee is in its infancy but once matured, the committee would be a good clearinghouse for new concrete technologies.
- A meeting was attended on the final day that included representatives of industry, private laboratories, and the government. The purpose of the meeting was to discuss laboratory accreditation. It was encouraging to see industry and government working towards a common goal. Based on the meeting there seems to be some confusion between the meanings of accreditation (evidence that a laboratory is capable of testing materials to a set of standards) and authorization (being allowed to provide testing on government projects). After the meeting there were numerous discussions regarding producer's laboratories being allowed to test competitor's materials on project sites, basically providing commercial testing services. It was suggested that the producers' laboratories be used to provide internal quality control testing and let the independent laboratories provide testing commercially.

## Recommendations:

The following are recommendations, in order of importance, for the implementation of the presented tasks.

- Distribute the translated European standards and test methods for concrete related materials. A list of the most important standards is presented in Annex II. [These standards have been made available to the Kosovo Standardization Agency, but the Agency has not promulgated them. KCBS will distribute to the four lab-operating companies immediately]. Once the standards are distributed and the producers have used the standards and test methods, reinforce the use by having an expert, familiar with concrete materials testing, go into each laboratory to address questions and verify that the standards and test methods are being applied properly.
- In the US, the chemical admixture and the cement manufacturing companies are developing new concrete technology. The new technology is introduced to the industry by technical sales staff working directly with the concrete producers. Since the admixture companies have far more to gain by increasing sales in this area, the Kosovo Association of Concrete Producers (KACP) should contact the admixture companies and work with them to establish technical sales representatives in Kosovo to work with the individual concrete producers. Initially one visit to Kosovo per month would be adequate until the individual establishes working relationships with the suppliers. KCBS could facilitate by making the initial introductions between the admixture personnel and the QC managers of the concrete suppliers. The QC manager for one concrete company has attended a class given by one of the admixtures companies; the class was given in Slovenia. It would be a benefit to have the admixture companies come to Kosovo.
- Expand the current education process to include architects and engineers. Educate the design community on the European standards and teach them how to specify concrete for strength and durability and how to interpret test results to determine conformance to the specifications. In addition, the industry is in dire need of construction documents that better specify construction materials including concrete.
- Encourage monthly meetings between designers, contractors, and materials suppliers, and government representatives to facilitate the exchange of new ideas and technologies. Have guest speakers attend and speak on the new technologies. As an example, ask a technical sales representative from an admixture company to speak on air-entrained concrete at one of the meetings. Make it a social event. Suggested topics are:
  - Durability of concrete
  - Accurately measuring strength of field placed concrete
  - Specifying concrete based on European standards
  - Proper concrete placement techniques
- Find individuals within the industry to champion the cause of more durable concrete through the use of chemical admixtures. Place the individuals on the concrete technical committee of the KACP. These individuals should be well trained. We know that one chemical admixture company has a training seminar that is held outside of Kosovo. Sending individuals to the class would give them an opportunity to visit a commercial laboratory to see how laboratories conduct the business side of the industry.

# CONCLUSIONS AND RECOMMENDATIONS FOR FUTURE ACTIVITY

Portland cement concrete is probably the predominant construction material used in Kosovo. Concrete is used in structural elements in residential and commercial construction as well as precast concrete pavers, curbs, and pipe. There are numerous untapped markets for portland cement concrete in Kosovo. If the durability of concrete can be increased concrete can be used in others types of construction such as paving, parking lots, sidewalks, or other types of flatwork. Concrete could easily be marketed as an inexpensive alternative to the concrete pavers currently being used in flatwork applications.

Making durable concrete and concrete products can be achieved by the use of inexpensive chemical admixtures. Utilizing the admixtures can result in using less cement, which is the most expensive constituent, per cubic meter of concrete. By lowering the cost of concrete the producer can increase profits while supplying a better product.

Introducing the concrete industry to newer technology will benefit the industry by lowering the material costs per cubic meter and increasing the durability of the concrete. Initially the introduction of air entraining and water reducing admixtures will greatly increase the consistency and durability of concrete and concrete related products. In addition to materials, increasing the understanding of proportioning concrete mixes and how to adjust concrete mix proportions will benefit the individual producer by increasing the efficiency of each concrete mix.

At this time, the producers should focus on working with water reducing and air entraining admixtures. The introduction of mineral admixtures (fly ash, and silica fume) would be somewhat overwhelming. As a side note, someone should investigate the feasibility of converting the local coal burning power plant into a source of fly ash (fly ash is the byproduct of coal burning power plants collected in the smoke stacks). There are many uses for fly ash including cement replacement in concrete (up to 25%), treating industrial waste in landfills, and increasing strength in construction subgrades. In addition collecting the particulate emissions from the power plant would reduce air pollution.

There exists a need in the industry to establish an individual, or individuals, who can constantly promote European standards, proper testing techniques, and the use of new technologies in concrete production. This would result in constant reinforcement of the new concepts in hopes that the new methods become the accepted standard of care. If the admixtures companies choose not to participate KCBS should consider funding a one year position to promote new technologies in concrete along with proper testing techniques for concrete and aggregates. In addition, the individual would be responsible to work with the government to establish construction standards and project specifications.

It is rumored that a commercial testing laboratory from Germany is considering moving to Kosovo. This may be a benefit to the concrete industry in that the German laboratory may force the local industry to raise its current standards to meet European laboratory standards. The impact on the concrete industry and acceptance of the German laboratory into the local market will be interesting to observe.

# ANNEXES

Annex I: Field Trip Summary Reports

Annex II: Standards and Test Methods Needing Translation

Annex III: Recommended Quality Control Tests and Frequencies

Annex IV: Field Visit Photographs

# ANNEX I – FIELD TRIP REPORTS

## FIELD TRIP SUMMARY REPORT

Date of Visit: April 3, 2007  
Site Visited: Renelual Tahiri, Prizren, Kosovo; Vellezerit e Bashkuar, Prizren, Kosovo  
Attending: Valdet Osmani, Eljesi Surdulli, Jeff Groom, Hetem Muharremi, Feriz Shabani, and Driton Kryeziu

The purpose of the field trip was to observe the laboratories of Renelual Tahiri, and Vellezerit e Bashkuar and discuss portland cement concrete mix proportioning, basic quality control (QC) test procedures and ascertain the current level of QC within the organization. Our tour included observation of equipment and discussions regarding the testing procedures and within laboratory QC procedures. A summary of our findings is presented below.

### Renelual Tahiri

- The laboratory is well equipped for routine in-house QC testing. The laboratory manager Hetem is knowledgeable in most QC test procedures (Yugoslav) and has computer capability to track QC test results. Hetem uses an equation based on the strength of cement to determine the compressive strength of his concrete. The equation is as follows:

$$F'c = k * C((1/ w/c)-0.5) \text{ where}$$

k = constant between 0.55 and 0.65

C = strength of cement (MPa)

w/c = water cement ratio

From the equation Hetem determines the desired water/cement ratio and then determines the water content for a given cement content.

- The company does not use water reducing admixtures or air entraining admixtures, although, they do use an air reducing admixture.

### Vellezerit e Bashkuar

- We made a short visit to Vellezerit e Bashkuar to make contact with Driton to plan the following day's activities. During the visit we discussed the use of air entraining admixtures and water reducers, both of which Driton would like to use in concrete production. In addition we discussed Driton's method of determining mix proportions. His method is based on each constituent being a specified percentage of the total mix mass.

## CONCLUSION

Both laboratories are currently using Yugoslav test results and both have some understanding of European Norms. Each laboratory could benefit from EU procedures and adjusting their mix proportion techniques to include the specific gravity of all constituents.

## FIELD TRIP SUMMARY REPORT

Date of Visit: April 4, 2007  
Site Visited: Renelual Tahiri, Prizren, Kosovo  
Attending: Valdet Osmani, Jeff Groom, Hetem Muharremi, Feriz Shabani, Driton Kryeziu, Bujar Hyseni, and Mond Sako

The purpose of the field trip was to demonstrate the EU procedures for determining basic concrete QC testing of fresh and hardened concrete. The demonstrations were performed using the laboratory and equipment of Renelual Tahiri. Specifically we demonstrated the following on a small sample of fresh concrete:

- Calibration of the unit weight bucket and air content gauge. (EN 12350-6:2000 Density and EN 12350-7:2000 Air Content (Pressure Method))
- Demonstrated the slump test EN 12350-2:2000
- Demonstrated the determination of density EN 12350-6:2000
- Demonstrated how determine the total air content of fresh concrete using the pressure method EN 12350-7:2000
- Demonstrating the casting and curing of strength specimens in accordance with EN 12390-2:2000
- Demonstrated the proper testing technique to determine the compressive strength of hardened concrete in accordance with EN 12390-3:2000

In addition, we briefly discussed tracking the test results and general testing procedures.

### CONCLUSION

As anticipated the individuals were somewhat familiar with the basic testing procedures such as casting tests samples in three layers and compacting each layer with 25 stokes of a tamping rod, etc. There were certain very specific parts of each procedure that were new such as the target time for raising the slump cone off of the test sample. Each client would benefit greatly by obtaining copies of the EU norms.

## FIELD TRIP SUMMARY REPORT

Date of Visit: April 5, 2007

Site Visited: Renelual Tahiri office, Prizren, Kosovo

Attending: Valdet Osmani, Jeff Groom, Hetem Muharremi, Feriz Shabani, Driton Kryeziu, and Bujar Hyseni

The purpose of the field trip was to present a rigorous Power Point presentation on quality control testing and analyzing test results to adjust portland cement concrete mix proportions. The presentation included the following information:

- A review of European Norm testing methods for fresh and hardened concrete
- Storing test results to easily conduct statistical analysis of the results
- Statistical analysis techniques utilized by the European Norms
- Presented a new method of determining concrete mix proportions using the specific gravity of each constituent to easily convert mass to volume and volume to mass. This method is more accurate than the methods currently used in Prizren area for determining concrete mix proportions.
- Adjustment of concrete mix proportions based on the statistical analysis and European Norm requirements for average compressive strength.

There was a long discussion on statistics and how to apply the statistics to testing data. In addition there was a discussion of different methods to test for compressive strength including the differences between the use of cylinder and cube shaped specimens.

### CONCLUSION

The EU standards use statistics to determine what the average compressive strength of a given class of concrete should be. The analysis uses the average compressive strength as well as the standard deviation of the data to determine an appropriate over design for compressive strength. I believe this was a new concept to some of the attendees. Follow-up visits to each attendee may benefit the transfer of knowledge for the concepts presented.

## FIELD TRIP SUMMARY REPORT

Date of Visit: April 6, 2007

Site Visited: Vellezerit & Bashkuar Laboratory, Prizren, Kosovo

Attending: Valdet Osmani, Jeff Groom, Hetem Muharremi, Feriz Shabani, Driton Kryeziu, and Bujar Hyseni

The purpose of the field trip was to present EN procedures for determining the class of concrete recommended for different corrosion inducing exposures. The presentation was based on information contained in EN 206-1:2000 *Concrete – Specification, performance, production and conformity*. In addition, proportioned concrete mixes utilizing superplasticizing and air entraining admixtures. The following information was presented and discussed:

- A discussion was had on different types of concrete needed for different corrosion inducing environments.
- A list of job duties was presented and discussed for QC laboratory technicians and QC manager position.
- Several concrete mixes were batched utilizing superplasticizing and air entraining admixtures. The mixes were being placed on forms for concrete curbs. The mixes were proportioned to have a w/c ratio of 0.33. The first mix was very stiff (dry) and hard to place. The second mix was made with white cement and had a slightly higher slump. The third mix had a very high slump.
- Testing was performed by QC technicians that were employed by Vellezerit & Bashkuar. Testing methods were observed and recommendations were made based on the procedures observed.
- Placement procedures were also observed. We observed the concrete was being over consolidated (vibrated) which results in driving the air (lowering the durability) from the mix. The concrete was being over consolidated to achieve a very smooth surface once the curbs were removed from the forms. We discussed changing the consolidation procedures. The change in procedures could result in a less smooth surface but the curbs would be more durable. Procedures were changed to accommodate the recommendations. We were notified later in the day that the surface of the curbs was acceptable and therefore I hope the change in procedures will be permanent.

There was further discussion regarding different methods of consolidation such as vibrating tables versus stinger type vibrators.

### CONCLUSION

The attendees were somewhat familiar with the nomenclature adopted by the EN standard. The concrete mixes made showed the trial and error approach needed when using the types of admixtures being utilized. The testing methods, in general, conform with EN standards except for a few minor changes that will result in more accurate testing (the laboratory technicians were not familiar with the proper use of the air meter. The proper procedures were reviewed.) The revised placement procedures should result in a more durable product and ultimately will save time during production. The primary change was eliminating the over vibration of each curb and utilizing a method where the production crew “stings” each curb five times across the length of the curb.

## FIELD TRIP SUMMARY REPORT

Date of Visit: April 7, 2007

Site Visited: Office of United Consultants Group, Laborator per Arkitekture, Pristina, Kosovo

Attending: Valdet Osmani, Jeff Groom, and Ilir Murseli, Director

The purpose of the field trip was to gain an understanding of how the different parties interact on a construction project. We discussed various phases of construction and in particular on project that was being designed by the United Consultants group. The following information was discussed:

- Communication between consultants, contractors and material suppliers on construction projects.
- How concrete is specified for construction projects.
- A design change for a project the United Consultants Group is currently designing. The current design calls for cast-in-place architectural concrete. We discuss the use of precast panels in lieu of the cast-in-place concrete. The architect was not aware that precast panels could be cast in Kosovo. We discussed the benefit of better quality control in preparing precast panels. In addition this design change could benefit a client of KCBS by allowing them to work directly with the design architect and providing a more technical concrete mix to achieve the appropriate esthetics the architect is seeking.

### CONCLUSION

Ilir Murseli has worked throughout Europe and understands the importance of project specifications and standardization of procedures. It is my opinion he could be an excellent resource to KCBS in their ongoing commitment to introduce standards to the construction industry in that, he has seen the benefits of such standardization as compared to the current method of construction in Kosovo. Based on our visit I also believe the architectural and engineering communities could benefit from exposure to EN standards.

## FIELD TRIP SUMMARY REPORT

Date of Visit: April 9, 2007  
Site Visited: Granit, Istog, Kosovo  
Attending: Valdet Osmani, Jeff Groom, and Ismet Loshaj, Company Director

The purpose of the field trip was to discuss the potential for Granit to develop a testing laboratory for its own use. In addition we hoped to discuss the use of additives in the concrete produced by Granit. The following information was discussed:

- Granit's primary focus at this time is the production of asphalt for road construction. Ismet said he primarily produces concrete for use on his projects as a secondary material.
- Ismet said he has focused on asphalt but he intends to focus more on concrete and the technological advances made in concrete production.
- Istog is a beautiful region surrounded by high mountains. We discussed the causes of concrete deterioration in the Istog area (freeze/thaw) and proper materials to be used for durable concrete. In addition we discussed concrete mix proportions needed for durable concrete. Specifically we discussed how the use of water reducing additives can help lower water/cement ratios. A lower water/cement ratio is necessary for durable concrete.
- There was a good discussion on the mechanisms involved in concrete deteriorated by freezing and thawing and how salt accelerates the deterioration.
- Ismet is interested in manufacturing lightweight concrete block. Lightweight block is manufactured with lightweight aggregates predominately volcanic tuft or pumice. Without a local source, the cost involved in shipping the material may make the blocks too costly to sell.

### CONCLUSION

Ismet Loshaj is in a prime position to benefit from the efforts of KCBS. He is showing some interest in establishing a laboratory and is currently erecting a new steel building that could easily house the laboratory. In addition, when Ismet investigates the newer technology (chemical additives) KCBS is in a good position to encourage Ismet to investigate the benefits of using chemical additives.

## FIELD TRIP SUMMARY REPORT

Date of Visit: April 10, 2007  
Site Visited: Papenburg and Adiani, Farizaj, Kosovo  
Attending: Valdet Osmani, Jeff Groom, Hetem Muharremi, Feriz Shabani, Driton Kryeziu, and Bujar Hyseni

The purpose of the field trip was to review mix design procedures using the specific gravity method of determining mix proportions. In addition, two concrete mixes were made and testing procedures were reviewed. A water reducing admixture was used in the second mix to demonstrate the benefit of using water reducing admixtures. The following was noted:

- The participants continue to struggle with the use of specific gravity to determine concrete mix proportions. The manual being used by most participants presents this method but boils the procedure down to an equation that can be used by individuals without truly understanding the procedure.
- The testing procedures and equipment used at Papenburg is vastly different than the methods and equipment used at Tahiri during a previous field trip. This is an indication that the procedures and equipment are in dire need of standardization.
- A concrete mix was made with and without water reducing additives. The 0.5 M<sup>3</sup> mix was initially batched without the additive. The participants noted how dry the mix appeared as observed at the back of the mixer truck. We then poured the water reducing admixture into the concrete and mixed for approximately minutes. We then placed the concrete into a wheel barrow and the participants observed that the concrete flowed and was more workable. The mix contained roughly 10% less water than the concrete mixes currently in use. Unfortunately the cube molds utilized by Papenburg were being used and a compressive strength specimen could not be cast.

### CONCLUSION

Basic quality control test methods need to be translated and distributed. Once the test methods and standards are distributed and being used, the principals discussed during these field trips should be reinforced with follow-up visits from concrete experts.

The benefit of using water reducing additives was demonstrated. Based on the observed differences between the concrete with and without the additive the benefit was obvious.

## **FIELD TRIP SUMMARY REPORT**

Date of Visit: April 12, 2007

Site Visited: Road Construction Project Albania (Border to Morine - Kukes)

Attending: Valdet Osmani, Jeff Groom, Feriz Shabani, Driton Kryeziu, and Eljesi Surdulli

The purpose of the field trip was to observe the concrete work associated with the road construction. We observed several retaining walls and box culverts in addition to one of the concrete plants and testing laboratories being used for the project. The following was observed:

- Several box culverts
- Several relatively tall retaining walls
- Aggregate crushing facilities, concrete batch plant, and testing laboratory.
- We met with the project engineers in Morine – Kukes and looked at the project specifications.

### **OBSERVATIONS / CONCLUSION**

The project is very impressive; a huge undertaking by any standards. Some of the concrete is being supplied by Vellezerit e Bashkuar out of their Prizren plant. Other concrete is being supplied by a concrete plant located about half way through the project. The on-site operation produces its own aggregates and all of the operations look to be relatively new.

We observed several concrete cubes being tested for strength. The testing on the project is specified to be in accordance with British standards. The testing observed did not meet the British standards because the loading of the specimens was too fast.

The project specifications were well written and easy to follow. The specified properties are easily attainable based on the materials and batching facilities. The project specifications allowed the use of air entraining admixtures but the use was not specifically required. This amazes me since some of the concrete will be used for bridge structures exposed to freezing and thawing, and de-icing chemicals.

# ANNEX II - STANDARDS AND TEST METHODS NEEDING TRANSLATION AND DISTRIBUTION

## STANDARDS AND TESTS FOR FRESH AND HARDENED CONCRETE

**EN 206-1:2000 CONCRETE – Specification, performance, production and conformity**

**EN 12350-1:2000 Sampling**

**EN 12350-2:2000 Slump**

**EN 12350-6:2000 Unit Weight (Density)**

**EN 12350-7:2000 Air Content (Pressure)**

**EN 12390-2:2000 Making and Curing test Specimens**

**EN 12390-3:2000 Compressive Strength of Test Specimens**

## STANDARDS AND TESTS FOR AGGREGATES

**EN 12620:2002 Aggregates for Concrete**

**EN 932-1:1997 Sampling**

**EN 932-2:1997 Reducing Sample Size**

**EN 932-5:2000 Equipment Calibration**

**EN 933-1:1997 Particle Size Distribution (Sieving)**

**EN 1097-6:2000 Particle Density and Absorption**

# ANNEX III - RECOMMENDED QUALITY CONTROL TESTING AND FREQUENCIES

## AGGREGATE TESTING

PROPERTY	TEST METHOD	FREQUENCY
Grading (Sieve Analysis)	EN 9330-1	1 per week for each aggregate
Aggregate density (specific gravity) and water absorption	EN 1097-6	1 per month for each aggregate

## FRESH CONCRETE\*

PROPERTY	TEST METHOD	FREQUENCY	NOTES
Slump	EN 12350-2	1 per day	
Density	EN 12350-6	1 per day	Compare actual density to density of mix based on proportions. Adjust mass of sand as necessary for yield.
Air Content	EN 12350-7	1 per day	
Cast compressive strength specimens	EN 12390-2	2 per week	Make 4 cubes for each test. Test 2 cubes at 7 days and test 2 cubes at 28 days

\* These tests should be performed every time concrete is sampled for testing. Tests should be conducted daily for each class of concrete batched.

## HARDENED CONCRETE

PROPERTY	TEST METHOD	FREQUENCY	NOTES
Compressive Strength	EN 12390-3	2 cubes at 7 days age 2 cubes at 28 days age	Cast 4 cubes per set



**Demonstrating Air Content Test**



**Demonstrating Positioning The Slump Cone**



**Learning to Read Air Meter**



**Performing unit weight test**



**Determining the slump of superplasticized concrete**



**Production crew vibrating concrete curbs. Note the line made by the vibrator down the middle of each curb. This is an indication of over vibration.**



**Discussing EU standards for classification of concrete**



**Participants in Presentation**



**Performing slump test at Papenburg and Adriani. Note the nonconforming method of consolidation**



**Air content test at Papenburg and Adriani**



**Testing compressive strength cubes**



**Adding water reducing admixture to concrete**