

# 2015 MONTANA SUMMER TRANSPORTATION INSTITUTE

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FHWA/MT-15-005/6439-366

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*Final Report*

*prepared for*  
THE STATE OF MONTANA  
DEPARTMENT OF TRANSPORTATION

*in cooperation with*  
THE U.S. DEPARTMENT OF TRANSPORTATION  
FEDERAL HIGHWAY ADMINISTRATION

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*October 2015*

*prepared by*  
Susan Gallagher

Western Transportation Institute  
Montana State University - Bozeman



RESEARCH PROGRAMS

**MDT**★

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# 2015 MONTANA SUMMER TRANSPORTATION INSTITUTE

## *Final Project Report*

by

Susan Gallagher

of the

Western Transportation Institute  
College of Engineering  
Montana State University – Bozeman

prepared for the

State of Montana  
Department of Transportation  
Research Programs

in cooperation with the

U.S. Department of Transportation  
Federal Highway Administration

October 2015

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16. Abstract The Western Transportation Institute (WTI) at Montana State University (MSU) hosted a Summer Transportation Institute (STI) from June 14 to June 26, 2015. The aim of the program is to introduce high school participants to career opportunities in transportation. The two-week residential program introduces participants to all modes of transportation, seeks to build creative problem-solving skills, and supports college and career planning activities. Students lived on the MSU campus while participating in a multidisciplinary academic curriculum, which included guest speaker presentations, hands-on laboratories, and field trips. Participants gained leadership skills while working on team design-build projects. During the evenings and weekend, STI students participated in educational, sports, and team-building activities. The 2015 STI program was comprised of fourteen rising tenth, eleventh, and twelfth grade students from 4 different counties in Montana and 3 additional states.			
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## **PROGRAM ADMINISTRATION**

1. Host Site: Western Transportation Institute, Montana State University
2. Address: PO Box 174250, Bozeman, MT 59717-4250
3. Project Director: Susan Gallagher
4. Length of Program: 2 weeks
5. Type of Program: Residential
6. Grade Level(s): Entering 10th, 11th, and 12th grades
7. Number of Students per Grade: 10<sup>th</sup> grade (8), 11<sup>th</sup> grade (5), 12<sup>th</sup> grade (1)
8. Number of Student Applications Received: 19
9. Number of Students Selected for Program: 19
10. Number of Students to Complete Program: 14

## **ABSTRACT**

The Western Transportation Institute (WTI) at Montana State University (MSU) hosted a Summer Transportation Institute (STI) from June 14 to June 26, 2015. The aim of the program is to introduce high school participants to career opportunities in transportation. The two-week residential program introduces participants to all modes of transportation, seeks to build creative problem-solving skills, and supports college and career planning activities. Students lived on the MSU campus while participating in a multidisciplinary academic curriculum, which included guest speaker presentations, hands-on laboratories, and field trips. Participants gained leadership skills while working on team design-build projects. During the evenings and weekend, STI students participated in educational, sports, and team-building activities. The 2015 STI program was comprised of fourteen rising tenth, eleventh, and twelfth grade students from 4 different counties in Montana and 3 additional states.

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# 1 INTRODUCTION

The Summer Transportation Institute (STI) hosted by the Western Transportation Institute (WTI) at Montana State University aims to address the nation's need for a diverse pool of transportation professionals by heightening pre-college student interest in transportation careers. Program activities are designed to enhance participants' problem-solving, communication, and critical thinking skills and to introduce them to the broad array of opportunities available in the transportation field. The 2015 STI hosted fourteen high school students on the Montana State University campus for two weeks during June. The curriculum included presentations and activities related to various transportation modes, transportation planning, infrastructure design, and safety. Academic activities were enhanced by field trips and hands-on design/build activities. The program also provided a career and college counseling component, and team-building activities.

## 2 COMMITTEE, PARTNERS, AND STAFF INFORMATION

### 2.1 Intermodal Advisory Committee

An Intermodal Advisory Committee (IAC), made up of representatives from government, industry, and academia, was formed to assist the STI program in developing a well-balanced curriculum, planning activities and field trips, obtaining technical expertise, and conducting strategic planning. Members of the IAC are listed in the Section I Attachment provided in Appendix A.

A teleconference was held with IAC members on May 26, 2015 to discuss the program. The meeting began with an overview of what had been accomplished to date. At the time of the teleconference, there were 11 confirmed program participants. Four new staff members were hired to fill the roles of academic coordinators, teaching assistants, and residence hall advisors for the program. New teaching staff were in the process of developing the program schedule. Planned field trips for the program were discussed with IAC members. Chad Welborn from the MDT Design Unit confirmed arrangements for the participants' field trip to the Montana Department of Transportation (MDT) headquarters in Helena. Lloyd Rue confirmed that a representative from the FHWA Division Office would also meet with the students while they were visiting Helena. Chad Welborn also confirmed that students from the MDT Design Unit would be available to help set up the crash attenuator ramp. IAC member Danielle Scharf planned to follow up with the Montana Chapter of the Institute of Transportation Engineers (ITE) regarding financial support from the Chapter for the STI.

### 2.2 Partners/Sponsors

A number of program partners contributed to the 2015 program. The MSU Department of Civil Engineering provided access to the bulk materials and transportation laboratories and laboratory equipment, and the Tait Computer Laboratory. Scott Keller, Civil Engineering department adjunct instructor, additionally donated his time to lead a session and field trip on wetlands mitigation. The Western Transportation Institute (WTI) made its Driving Simulation and instrumented vehicle laboratory available to students and provided use of

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its classroom and A/V equipment for classroom activities. The Montana Department of Transportation provided staff time during the field trip to Helena. Chad Welborn (MDT Design Unit) and IAC member Scott Keller escorted students on the Helena field trip. Ryan Haskins, flight instructor from Summit Aviation and Director of Aviation Technology at Gallatin College, set up tours and discovery flights at the airport. Kittelson and Associates, Inc. (KAI) provided staff from their Boise, Idaho and Bend, Oregon offices to lead two new modules; one on “Public Involvement, Context Sensitive Solutions, and What it All Means,” and a second on “Traffic Engineering...the Ins and Outs of Traffic Signals on Main Street.” KAI additionally provided cost share to bring staff to Bozeman to participate in the program, and an article on the partnership was developed for their blog “Streetwise.” Partners are listed in the Section I Attachment in Appendix A.

### **2.3 Program Staff**

Full-time program staff included the Project Director, an Academic Program Coordinator, two Teaching Assistants, and two Residence Hall Advisors (RAs). Teaching staff were responsible for assisting with the development of classroom and hands-on activities, leading classroom activities, and assisting guest instructors with classroom management. The RAs were hired to supervise students during weekends and evenings and to plan and lead leadership, recreation, and team-building activities.

A number of full-time research staff from the Western Transportation Institute as well as faculty from the Civil Engineering Department contributed to the development of the STI curriculum. Guest speakers also included staff from program partners Summit Aviation, MDT, and Kittelson and Associates, Inc. All teaching and program staff are listed in the Section I Attachment in Appendix A. The STI topic presented by each instructor is given in parentheses after the person’s title.

## **3 PROGRAM OBJECTIVES**

The objectives of the MSU Summer Transportation Institute are to:

- Increase students’ awareness of the significance of transportation in their daily lives;
- Expose high school students to the variety of transportation careers available and demonstrate how transportation professionals work to identify and solve real-world issues that have society-wide impacts;
- Increase students’ understanding of the importance and need for creative and innovative transportation solutions;
- Develop communication and collaboration skills; and
- Provide college and career guidance.

The success of the program in meeting these objectives was evaluated based on 1) an assessment of the program curriculum in covering all relevant topics; 2) student responses to program evaluations administered after each activity; and 3) student responses on evaluations administered at the end of the program, which requested an overall assessment of all program aspects. Results from evaluations are included in the *Evaluations* portion of this report.

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## 4 MARKETING & STUDENT SELECTION PROCESS

Posters, announcements, and applications about the program were sent in January 2015 to principals and guidance counselors at Montana high schools. Program information and application forms were also posted on the WTI website. MSU representatives distributed information about the STI program at college fairs held on Montana reservations and application packets were sent separately to programs that serve Native American students and other underrepresented or underserved groups including Upward Bound, Gear Up, and Talent Search. Students entering the 10<sup>th</sup>, 11<sup>th</sup>, or 12<sup>th</sup> grade were encouraged to apply for the program.

Nineteen applications were received and all nineteen applicants were accepted into the program. Seventeen applicants confirmed their intent to participate and returned all permission forms and paperwork as required. One participant was a no-show, and two additional student attended the first two days of the program, but elected to leave the program early due to conflicts with planned sports activities. Fourteen students completed the two week program. The Demographic Data Summary for 2015 STI participants is provided in Appendix B.

## 5 PROGRAM CURRICULUM

### 5.1 Academic Program

The 2015 Summer Transportation Institute at MSU involved students in a comprehensive academic program. Topics covered included traffic engineering and planning, infrastructure design, aviation, safety and human factors. STI participants learned about career opportunities from professionals representing public and private sector transportation organizations as well as academia. Hands-on activities related to each topic helped to develop students' problem-solving skills and reinforced what they had learned. In addition to classroom activities, students participated in a number of team design/build projects, including crash attenuator, glider, and balsa wood bridge competitions. The team projects served to build teamwork and communication skills while fostering creative problem solving.

Components of the academic program are outlined in detail below, and a daily schedule is provided in Appendix D.

#### Roads and the Environment

Scott Keller, from the Montana Department of Transportation Design Unit, introduced students to the concept of conservation banking and presented a wetlands mitigation project that the MDT Design Unit conducted with assistance from undergraduate student interns. The students were able to visit the site following his presentation.

Students toured the MSU Subzero Laboratory, a cold room used for research on snow, ice, and winter conditions. The laboratory is used for transportation research related to infrastructure materials, freeze/thaw, frost heave, deicers and avalanches. Students were able to experience snow falling in June and to hear about research efforts currently being undertaken in the lab.

Rob Ament, WTI Program Manager, introduced road ecology research to STI participants. He discussed a number of projects designed to mitigate negative road impacts on wildlife, including highway fencing, wildlife crossing structures, and animal detection and driver warning systems.

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Rebecca Gleason, WTI Research Scientist, spoke to the group about livability principles and active transportation. She focused on how planning, design, and construction of transportation infrastructure needs to take into consideration all users, including bicyclists and pedestrians. The students took a tour of some area biking and walking trails.

#### Traffic Engineering and Planning

Scott Beard, P.E., Associate Engineer with Kittelson & Associates, Inc. in Bend, Oregon, provided an overview on the importance of traffic timing and signalization for traffic management. Scott is working on a traffic signal timing project on Main Street for the City of Bozeman, and students learned about this project, about the various mechanisms used to detect vehicles as they approach the intersection, as well as the average times allowed for pedestrians to cross an intersection. They were then able to visit a traffic signal box to see firsthand how they are programmed and operated.

WTI researcher, Pat McGowen, discussed transportation planning and introduced the students to the traffic simulation programs Synchro and TrafficSim. Participants learned about carrying capacity, congestion, and forecasting. They then experienced being transportation engineers through a hands-on activity that explored the impact road design has on congestion. Participants used intersection counters to "map" a local intersection by counting the cars that were traveling certain directions. They then determined how the intersection would be able to handle forecasted traffic loads in the future using traffic simulation programs. Using the software, they were able to explore various redesigns of the intersection to improve traffic movement.

Robyn Austin, Public Involvement Specialist for Kittelson and Associates, Inc. in Boise, Idaho, presented information on the importance of public involvement during the design stage of transportation projects. She then led a number of hands-on activities to guide the students through this process. Students were asked to represent different interest groups and then to design a roadway based on those interests. Robyn provided basic parameters for the roadway width and then asked the students to combine foam mock-ups of traffic lanes, bike lanes, landscaping strips, sidewalks, etc. in any configuration to match the width requirement. Students were then asked to explain their final roadway designs based on their interest group perspective. A second group exercise involved using different colored thread to mark a city map with preferred biking routes based on convenience and safety. The resulting map was used to highlight needed bicycle infrastructure improvements based on biker preferences.

#### Geotechnical Engineering

Erin Hafla, Graduate Research Assistant in Civil Engineering, introduced STI participants to the field of geotechnical engineering. After learning basic concepts, various soil properties were physically demonstrated. The importance of soils as foundations for structures, including roadways, was emphasized. Students demonstrated their acquired knowledge of soil properties in a laboratory competition. Student teams designed and built small scale, reinforced soil retaining walls. The walls were subjected to increasing loads until they collapsed.

#### Concrete

STI participants were introduced to concrete, a frequently used material for construction of transportation infrastructure. They learned about the various components that make up concrete

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and concepts behind concrete mix design. The students then made trial concrete batches in the laboratory using different mix designs. Samples were cast and cured from each trial batch for material property testing. Equivalent samples that had been previously cast and cured were then subjected to material property testing using compression equipment in the lab. The compression tests demonstrated the differences in concrete strength that resulted from different design mixes. Mike Berry, a Professor in Civil Engineering, facilitated these activities.

### Bridge Design

Civil Engineering Professor Damon Fick introduced students to bridge design and demonstrated a number of basic mechanics principles using foam, balsa wood, and reinforced and unreinforced concrete beams. Students were then guided in using design software to build and test a bridge virtually. Students also worked in teams of two to design and build a small scale, balsa wood truss bridge. The teams competed in a formal competition where loads were added to the bridges until they failed. Awards were given based on efficiency, aesthetics, and craftsmanship.

### Aviation

The students visited the Gallatin Field Airport and toured a number of its facilities. They spoke to professionals in security, fire and rescue operations, and airplane maintenance. The students met flight instructors at Summit Aviation, and experienced a thirty-minute “discovery flight” in the school’s small training aircraft. Students also participated in a hands-on glider design/build challenge. Working in teams of two, gliders were designed and built based on knowledge gained during flight trials that experimented with wing placement and nose weight. Final glider designs were reviewed and tested in a competition. Awards were given for aesthetics and engineering.

### Traffic Safety and Human Factors

STI participants were introduced to human factors research as a critical component of traffic safety studies. They learned how researchers use driving simulation laboratories to safely conduct human factors research. Participants were able to explore how WTI’s instrumented vehicle is equipped and used for human factors safety research. Human Factors Graduate Research Assistant Kaysha Young facilitated these activities.

Participants additionally learned about roadside hazards and crash attenuators. They then formed engineering teams and were challenged to design and build a crash attenuator as economically as possible out of provided materials (plastic bags, cotton balls, straws, etc.). The team able to build the cheapest and most efficient crash attenuator won an award. The attenuators were tested using a ramp, a toy truck, and an egg (as passenger).

### Field Trips

Field trips supplemented classroom and laboratory activities, providing students with an opportunity to meet and speak with practicing transportation professionals. Students participated in two field trips during the program as described below as well as a site visit to a local wetlands mitigation project.

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### *Gallatin Field Airport*

STI participants toured airport fire and rescue, aircraft maintenance operations, and Summit Aviation flight school during a field trip to the airport (described above as part of the aviation module).

### *Montana Department of Transportation*

STI participants visited the headquarters of the Montana Department of Transportation (MDT) in Helena, Montana. MDT staff met with STI participants to discuss transportation issues and careers. The MDT Research Unit provided an overview of the history of transportation in Montana, including land and water transportation, and environmental concerns. STI students were treated to a tour of the Computer-aided Design unit at MDT. Following the tour of MDT, the students took a train ride through the Last Chance historic district of Helena.

## **5.2 Enhancement Program**

The enhancement program was designed to prepare students for college and to promote career self-awareness. The desired outcomes for the enhancement program were for students to: 1) better understand the steps necessary to enter college; 2) better understand what college majors are available and coursework requirements for those majors; 3) develop employability tools; and 4) better understand potential career paths.

A representative from the MSU Admissions Office spoke with STI participants about college entrance exams, college preparatory coursework, choosing an academic major, obtaining financial aid, and academic support services available for college students.

In order to enhance students' career awareness, participants took the on-line "Strong Interest Inventory," a test designed to highlight a person's strengths and interests in relation to potential career fields. A representative from the MSU Career Services Office met with students to distribute and discuss the results of the Strong Interest Inventory and to help students put the information into context. The presentation emphasized the importance of developing employability skills, including good resumes and interviewing skills.

The Department Head in Civil Engineering, Dr. Jerry Stephens, provided the students with an overview of the Civil and Construction Engineering program at MSU and career development in these fields. His presentation included course requirements for Civil Engineering majors, licensing requirements for engineers after graduation, and professional certifications and continuing education for practicing professionals.

## **5.3 Sports and Recreation Program**

The objectives of planned weekend and evening activities were to provide students additional experience working in teams and to promote a spirit of collegiality and good sportsmanship among the STI participants. Each evening, the Resident Advisors (RAs) organized ice-breakers, team-building activities, and team sports. Activities were varied to cater to the variety of interests within the group. Activities included: basketball, soccer, board games, and hikes. Students attended a free outdoor Shakespeare play on campus, and visited the Museum of the Rockies and local farmer's market.

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## 5.4 Orientation and Closing Awards Program

STI participants arrived on campus on Sunday, June 14 and moved into their dormitory rooms with the assistance of the RAs and teaching staff. After the new arrivals were situated, an orientation was held for the students and parents. All staff members were introduced and an overview of planned STI activities provided. STI rules, regulations, and expectations were reviewed in detail as well as consequences for non-compliance. The following day, students received an orientation to the academic program and participated in a tour of the Montana State University campus.

Family members of STI participants as well as STI instructors, sponsors, and IAC members were invited to the STI Closing Ceremony held on June 26, 2015. The closing ceremony was completely planned by the STI students. The participants compiled a video presentation of their STI experience to present to their parents and other attendees. Each student received a certificate of completion from STI staff. Winning design-build teams received special recognition for best design and construction of balsa bridges, gliders, and crash attenuators.

## 6 EVALUATIONS

### 6.1 Classroom Session Evaluations

Daily evaluations, which encouraged narrative input from the students in the form of a daily journal, were administered to the students. In addition to quantitative questions, the daily journals asked questions specifically focused on knowledge gained from each course module. The questions were designed to foster reflection on each day's activities. A sample of student comments provided on various classroom sessions in response to reflective questions is given below.

#### Structures/Balsa Bridge Building Activity:

- *The two most interesting concepts that I took away from Mr. Fick's presentation were the economy of building a bridge and the consideration of design loads. I wasn't familiar with the field of structural engineering before today. This knowledge is important to the field of transportation because of the different structures that we make for transportation. Negative consequences that can occur from the lack of understanding of material properties include infrastructure failure, loss of life, etc.*
- *I thought it was interesting how just a little reinforcement (i.e. metal in concrete) can improve the strength [of a structure] exponentially.*

#### Concrete/Structures Activity:

- *I thought that the fly ash and glass was cool because it is completely recyclable and each material is readily available.*
- *My favorite activities were the bridge building and concrete activities because they are my first-time experiences with engineering projects.*
- *I found the concrete presentation very interesting. I really liked pulling the steel rebar apart.*
- *I enjoyed making concrete. Me and my group I thought were able to all participate and help in some way.*

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### Geotechnical Activity:

- *I had not heard of geotechnical engineering before the presentation. I liked the reinforcement and retaining wall activity because it was hard to build a wall using a lot of dirt but barely any toilet paper.*
- *It was crazy to think that a couple squares of toilet paper can really affect the strength of a tub of material.*
- *Soil properties are very important for transportation because it prevents a road from collapsing, shifting, or degrading. I had not heard of the applications of geotechnical engineering before but the soil reinforcement activity was fantastic.*
- *Three reasons knowledge of soil properties is essential for transportation professionals are: road construction safety, retaining wall strength, and lifespan of support under the road.*

### Traffic Engineering/Transportation Planning Activities:

- *Public involvement is important for transportation projects because the opinions of the people who live in that community are the most important. For instance, a roundabout might not be a usable solution in a community because it might block driveways.*
- *Context sensitive design is designing something based on its surroundings and how people react to your plans. Public involvement is important because you need public support for something to go smoothly.*
- *I didn't know that intersections were so expensive. I also thought it was interesting how roundabouts work. I think taking data from a camera would be much easier than the way we did it.*
- *The two things I found most interesting were how much roundabouts can ease traffic and how latent use makes an empty road congested.*
- *The traffic simulators were slightly inaccurate. The flow of pedestrians came all at once. However, they could give a community a visual representation of how a new intersection will look in the future.*
- *I liked the presentation on signal boxes, and how each and every part works. I also liked looking at a real box at the Kagy and 11<sup>th</sup> intersection.*
- *The impact of signal timing can either cause efficient flow of traffic or have a lot of congestion if done badly. I would have liked to hear how the records of the video footage are kept and if they are used.*
- *The activities today were interesting. I particularly liked going to see the stoplight control box because we rely on those working on a daily basis. Also, the presenter kept the presentation fun with interactive games and challenges.*
- *Signal timing is important because an incorrectly timed signal could cause an entire street to be backed up, which would seriously upset drivers. I would have liked to hear more about what kind of intersections work best in what environment.*

### Miscellaneous presentations/activities:

- *I was surprised that there are only 3 places in the world (including MSU) that have a subzero lab like the one we saw today. I was interested in how scientists study organisms that live in the Antarctic in order to prepare them in case there are organisms on Mars. [Subzero lab tour]*



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- *Before this, I didn't even know what a crash attenuator was, but the amount of work that went into it blew me away. [Crash attenuator activity]*
  - *There could be better crumple zones in cars [to make roads safer]. [Crash attenuator activity]*
  - *I never realized how complex transporting freight is. It made me wonder if the money made from solar roadways is worth more than the taxes, because the funds are decreasing to help road repairs. [commercial vehicle presentation]*
  - *The Montana Department of Transportation was involved in designing wetlands because they have to build as much wetlands as they destroy. I-90 went through some wetlands that were destroyed and other road projects in the area also destroyed some. The wetlands on I-90 are a project to compensate for all those building projects. [wetlands mitigation fieldtrip]*
  - *I think it is crazy how the U.S. only has 6% of people who actually use active transportation. However, I think this rate is how it is because the U.S. doesn't put a lot of stress on active transportation. In my area, commutes can be many miles long, so biking to work is usually out of the picture. [livability activity]*
  - *About 40% of my mobility is an active transportation mode. But public support is kind of lacking beyond cars in my community. [livability activity]*
  - *Camp is going very well. I can't wait for the rest of the activities.*

#### Career and College Enhancement Activities:

- *Civil Engineering does factor into my future career options. Previously, I didn't think so because it was only bridge building, but now I know there is so much more. I think I would like environmental engineering, because it appealed to me most. Chemistry, physics, and biology are probably needed. [Intro to Civil Engineering]*
- *[Internship] opportunities are huge and help students understand their jobs better by getting to practice before. [College 101 presentation]*
- *I learned that students can become paid interns at engineering firms. These are probably extremely important, because real experience helps a lot in the real world. [College 101 presentation]*
- *I think it is important for people to get practical, hands-on experience in college because it makes sure you like what you are doing. An internship could save you from working and disliking it later on in life. Internships also give you experience that can be desirable in some firms. [College 101 presentation]*
- *I found it interesting that MSU has such a huge out-of-state scholarship. I personally have not started college applications because I am a sophomore. This class helped me select what kinds of colleges I like and the perks of applying (i.e. super score SAT, early admission rebate). [College 101 presentation]*
- *The orientation information and the tour was very informative. I had a lot of fun with the activities.*

The quantitative portion of daily evaluations allowed students to indicate their level of agreement with a specific statement using the following scale:

5 = Strongly agree

4 = Agree

3 = Neutral

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2 = Disagree

1 = Strongly Disagree

These questions were used to gauge whether the students received adequate assistance and sufficient explanation for each topic covered.

Average scores for agreement with statements on classroom activities are summarized in Table 1. Average scores for student responses ranged from 4.1 to 4.8.

**Table 1: Student Classroom Evaluation Summary Scores**

Statement	Traffic Signals	Human Factors	Traffic Engineering	Concrete/Structures
Students were able to ask questions and discuss related issues during the course of the activity.	4.8	4.7	4.7	4.7
The presentation related well to the laboratory or field activity that followed.	4.7	4.1	4.6	4.8
The instructor provided sufficient explanation of the concepts covered.	4.7	4.6	4.4	4.6

Summary evaluation scores for the question, “did instructor provide sufficient explanation of concepts covered?” is given in Table 2 for guest presenters. Average scores range from 4.3 to 4.8.

**Table 2: Guest Speaker Evaluation Scores**

Speaker/Topic	Score
Fick/Structures	4.8
Ament/Road Ecology	4.6
Austin/Public Involvement	4.6
Stephens/Commercial Vehicles	4.8
Hafla/Geotechnical Engineering	4.5
Gleason/Livability	4.3

## 6.2 Field Trip Evaluations

STI participants also provided narrative feedback on the field trip to the Gallatin Field Airport in Bozeman. The field trip included discovery flights at Summit Aviation as well as an airport tour to fire and rescue, the air traffic control tower, and maintenance areas of the airport. The trip was designed to introduce participants to the variety of aviation careers available. Sample comments from student journals are provided below.

- *I learned a ton more about airports that I had not known before. We got to see the air traffic control tower and fire station.*
- *Being in those planes was one of the most memorable things in my life. It was cool to learn how the airport practically is a city of its own.*

- *The airport has a lot of jobs: police, firemen, ground control, air control, sign makers, runway clearers...*
- *It was really fun to fly for the first time. I really want to fly now and I learned you can get a license at 15.*
- *I thought it was interesting to see (feel) how different a small plane is versus a bigger plane. Becoming a pilot in Montana seems like a fun and achievable (albeit expensive) goal. The thing that surprised me the most was how pilots have to teach (in order to get hours) before they can become a commercial pilot.*
- *I learned about the massive variety of careers. I liked maintenance because of the variety of jobs. I got a good overview of aviation careers.*
- *I learned that there are a variety of jobs that aren't directly pilots or flight attendants, such as making sure the runway is clear or being a fireman. I thought that being in the maintenance part would be the coolest as I could make signs and do other cool things. I thought we should have heard more about ground crews, but I thought I got a good overview.*

### 6.3 Staff Evaluations

Three STI teaching staff led the design-build activities, coordinated guest speakers and hands-on activities, and ensured continuity for the academic program. In the evenings, two Residence Hall/Recreation Advisors were responsible for designing and leading team-building and sports and recreational activities for the participants. STI staff evaluations were very positive. As shown in Table 3, students felt that STI staff were friendly and approachable, and were there for them if they had questions or problems during the camp.

**Table 3: STI Staff Summary Evaluations**

Statement	Average Score
The teaching staff was available when I had a question or needed assistance	4.6
The teaching staff was friendly and considerate	4.8
The teaching staff encouraged students to strive for excellence in camp projects and activities	4.8
The teaching staff explained assignments well and provided assistance when necessary	4.6
The RA staff was helpful when I had problems	4.7
The RAs were available when I had a question or needed assistance	4.8
The RA staff planned fun recreational and sports activities that were inclusive	4.9
The RAs helped to build group atmosphere through team projects and games	4.8

Scale: 5= Strongly agree; 1= Strongly disagree

## 6.4 2015 STI Overall Program Evaluation

An end of program survey was administered to gauge how students' attitudes toward college and career choices, engineering, and MSU, may have been changed by the program. The survey also evaluated the success of the program in meeting its objectives to: 1) increase participants' awareness of the significance of transportation; 2) expose participants to the variety of transportation careers available; 3) improve participants' understanding of the society-wide impacts made by transportation professionals; and 4) increase students' understanding of the need for innovation in transportation.

Eleven participants completed the overall program evaluation (although a few respondents skipped questions). The program was very successful in meeting its stated objectives in that all eleven respondents agreed that they better understood the importance of innovation in transportation, better understood better how transportation professionals identify and solve problems that impact people in everyday life, and they learned more about transportation careers. In addition, ten respondents indicated the program better prepared them for college, helped them better understand the importance of college preparatory coursework, and helped them feel more confident about their ability to handle college courses. Nine of the eleven respondents indicated that the STI helped them feel more confident about future college and career choices, and helped them to develop their problem-solving skills.

Table 4 provides a breakdown of student responses to end of program evaluation questions.

**Table 4: End of Program Survey Summary**

	Number of Responses				
	<i>Strongly Agree</i>	<i>Agree</i>	<i>Neutral</i>	<i>Disagree</i>	<i>Strongly Disagree</i>
<b>STI Participant Goals</b>					
1. I was able to meet other students with interests similar to mine.	5	6			
2. I was able to design and build projects.	6	4			
3. I was able to learn more about careers in transportation.	9	2			
4. I had fun while attending STI.	6	5			
5. STI helped me prepare for college.	7	3	1		
6. I was able to learn more about engineering.	8	2	1		
7. I would recommend the STI to other students.	6	2	3		

	Number of Responses				
	<i>Strongly Agree</i>	<i>Agree</i>	<i>Neutral</i>	<i>Disagree</i>	<i>Strongly Disagree</i>
8. I was able to learn more about Montana State University.	6	5			
9. Before the STI, I was interested in majoring in engineering.	7	4			
10. After the STI I would consider majoring in engineering.	7	3			
11. Before the STI, I was interested in attending MSU.	3	4	1	3	
12. After the STI, I would consider attending MSU.	5	3	1	2	
13. The camp helped me to understand better the importance of college preparatory class work.	3	7	1		
14. I feel more confident now about making future college and career choices.	6	3	2		
15. I feel better able to work on a team project.	2	6	3		
16. I feel more confident that I can handle college courses.	3	7	1		
<b>Speakers</b>					
1. The speakers aligned with what I expected out of the camp.	5	4	2		
2. I enjoyed the speakers.	5	4	1	1	
3. The speakers led me to consider majoring in engineering.	5	6	1		
4. The speakers led me to consider attending MSU.	4	4	1	2	
5. I learned about the importance of different modes of transportation.	6	4	1		
6. I understand better how transportation professionals identify and solve problems that impact me in everyday life.	9	2			

	Number of Responses				
	<i>Strongly Agree</i>	<i>Agree</i>	<i>Neutral</i>	<i>Disagree</i>	<i>Strongly Disagree</i>
7. I understand better how important innovation is for transportation.	7	4			
8. Camp presentations and activities helped me to develop my problem-solving skills.	5	4	2		

## 7 FINANCIAL REPORT

The 2015 STI received a budget of \$40,000. In addition to expending the grant amount, the program received funds and in-kind support from a number of sources. The Montana Department of Transportation Design Unit provided the equivalent of \$480 in in-kind support. Design Unit staff helped with project set-up (for the crash attenuator) and organized and chaperoned the MDT headquarters field trip to Helena. Kittelson and Associates, Inc. provided the equivalent of \$2,729.40 in cost-share to cover travel and other related expenses to bring two staff members to Montana from Bend, Oregon and Boise, Idaho to lead course modules. A preliminary financial report (Section III Attachment) is presented in Appendix C.

## 8 SENIOR SURVEY DATA

In order to gauge the impact that the Summer Transportation Institute had on participants' career and college choices after high school, a survey was emailed and mailed to former STI participants the summer following the completion of their senior year in high school. In total, 120 participants from the 2007-2014 programs had graduated high school by summer 2015. Of the 120 graduates, 45 students responded to the survey (a 38% survey success rate). Data from thirty-nine respondents was incorporated into the 2009-2014 annual reports. Six additional responses were received in 2015. A breakdown of 2015 survey responses is provided in Table 5 below.

**Table 5: Senior Survey Responses**

<b>Survey Question</b>	<b>Yes</b>	<b>No</b>
Did you apply to college?	4	2
Are you currently enrolled in college?	4	2
Did the STI experience impact your decision to attend college?	3	1
Did your STI experience help you in choosing a major?	3	1
Did your STI experience help prepare you for college entrance?	4	0

Four respondents had applied to and were enrolled in four-year institutions of higher education. All four college attendees were enrolled in science and engineering programs (one in Mechanical Engineering, one in Civil Engineering, one in Computer Science, and one in Chemistry). Two program alumni were enrolled in engineering programs at Montana State University. The other

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two were attending University of Washington and Western Washington University. Two alumni were employed full-time, one as a mechanic.

The senior survey asked respondents for narrative comments on how the STI affected their choices after high school. The responses highlight the impact the program had on helping students to explore engineering as a field and to select a college.

- *I loved the atmosphere of living in the dorms, friends to chat with right down the hall, and the community feeling of playing sports together around campus. I enjoyed the classes and the professors and it made me very much look forward to going to college.*
- *I loved STI. I still refer to it pretty often as the closest thing I've had to college experience. I talked about it in many of my applications to colleges, how it affected my life and the things I learned there. I also still remember random facts I learned like "don't veer for the deer" and share them with other people. I loved being able to spout off random facts about bridges, Montana highways, and future plans for things like animal crossings over the highways. I really liked that we hear from geological, structural, civil, environmental, mechanical, engineers. The projects and tests we participated in were not only fun but excellently demonstrated the subject at hand. The two I can think of off the top of my head are the building a retaining wall for dirt out of various materials (ribbon, paper, toilet paper, tape) and the truck, ramp and egg. To me this very well demonstrated the balance which engineering is to me; creating safest workable solution for the lowest cost. The RAs with our group were also fantastic and gave us great tips for college life.*
- *Before attending the camp, I knew I wanted to be an engineer, but I wasn't sure what type. I really enjoyed the activities that we did in the camp and later decided that it was what I wanted to do for the rest of my life.*
- *The program helped me decide what I want to major in. Even during high school, the program led me to enroll in an internship through my high school at the Department of Transportation in Helena, where I got to further explore the different aspects of civil engineering and see the actual application. After the internship, I was sold on civil engineering and even got a scholarship from the College of Engineering here at MSU! I'm so thankful for being a part of the STI program.*
- *After participating in STI, quite frankly I found out that I wasn't probably going to go in Civil Engineering which narrowed it down for me [enrolled in Mechanical Engineering program.]*
- *It helped me think about what I really want to do before I go to college.*

## 9 RECOMMENDATIONS

The 2015 program involved private industry in developing and leading several curriculum modules. This collaboration is an excellent opportunity to demonstrate to students real-world career opportunities in transportation. Kittelson and Associate, Inc. provided a realistic view of transportation consulting work from the practitioner side. The STI program would like to continue this collaboration and strive for additional industry involvement in future years.

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## 10 APPENDIX A: SECTION 1 ATTACHMENTS

### *National Summer Transportation Institute Program - Annual Report*

#### *Section I: Inter-modal Advisory Committee (IAC)*

<b>State: Montana</b>	
<b>Fiscal Year: 2015</b>	<b>Host Site: Montana State University</b>

<b>Name:</b>	Chad Welborn
<b>Title:</b>	Design Supervisor
<b>Organization:</b>	MDT Design Unit

<b>Name:</b>	Kris Christensen
<b>Title:</b>	MDT Project Manager for STI
<b>Organization:</b>	Montana Department of Transportation, Research

<b>Name:</b>	Scott Keller
<b>Title:</b>	Adjunct Instructor
<b>Organization:</b>	MSU Civil Engineering Department

<b>Name:</b>	Lloyd Rue
<b>Title:</b>	Program Development Engineer
<b>Organization:</b>	Federal Highway Administration, Montana Division

<b>Name:</b>	Danielle Scharf
<b>Title:</b>	Associate/Senior Engineer
<b>Organization:</b>	Sanderson Stewart



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***National Summer Transportation Institute Program - Annual Report***

*Section I: Partners/Sponsors*

State: Montana	<b>Host Site: Montana State University</b>
Fiscal Year: 2015	

Name:	Ryan Haskins
Title:	Director, Aviation Technology
Organization:	College of Technology/Summit Aviation
Role/Contribution:	Airport tour arrangements

Name:	Andy Daleiden, PE
Title:	Associate Engineer
Organization:	Kittelson & Associates, Inc.
Role/Contribution:	Cost-share/Curriculum support coordination

Name:	Chad Welborn
Title:	Design Unit Supervisor
Organization:	MDT Design Unit
Role/Contribution:	MDT tour arrangements

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***National Summer Transportation Institute Program - Annual Report***

***Section I: Summer Transportation Institute Program Staff***

State: Montana	<b>Host Site: MSU Western Transportation Institute</b>
Fiscal Year: 2015	

Name:	Scott Keller
Position Title:	Adjunct Instructor (Wetlands mitigation)
Affiliation:	Civil Engineering Department, Montana State University

Name:	Dr. Mike Berry
Position Title:	Professor (Infrastructure materials)
Affiliation:	Civil Engineering Department, Montana State University

Name:	Dr. Patrick McGowen
Position Title:	Research Engineer (Transportation Planning)
Affiliation:	Western Transportation Institute, Montana State University

Name:	Erin Hafla
Position Title:	Graduate Research Assistant (Geotechnical Engineering)
Affiliation:	Civil Engineering Department, Montana State University

Name:	Dr. Jerry Stephens
Position Title:	Professor (Structures)
Affiliation:	Civil Engineering Department, Montana State University

Name:	Kaysha Young
Position Title:	Graduate Research Assistant (Human Factors)
Affiliation:	Western Transportation Institute

Name:	Dr. Damon Fick
Position Title:	Professor (Structures)
Affiliation:	Civil Engineering Department, Montana State University

Name:	Rebecca Gleason
Position Title:	Research Associate (Livability/ Active Transportation)
Affiliation:	Western Transportation Institute

Name:	Rob Ament
Position Title:	Program Manager (Road Ecology)
Affiliation:	Western Transportation Institute

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***National Summer Transportation Institute Program - Annual Report***

***Section I: Summer Transportation Institute Program Staff***

State: Montana	
Fiscal Year: 2015	<b>Host Site: MSU Western Transportation Institute</b>
Name:	Susan Gallagher
Position Title:	STI Project Director
Affiliation:	Western Transportation Institute

Name:	Amanda Ricker
Position Title:	STI Academic Program Coordinator
Affiliation:	Western Transportation Institute

Name:	Carl Poeschl/Dawn Sturman
Position Title:	STI Teaching Assistants
Affiliation:	Western Transportation Institute

Name:	Beker Cuelho
Position Title:	Residence Hall Advisor (STI)
Affiliation:	Western Transportation Institute

Name:	Amanda Williams
Position Title:	Residence Hall Advisor (STI)
Affiliation:	Western Transportation Institute

## 11 APPENDIX B: DEMOGRAPHIC SUMMARY REPORT

FY 2015 _____
National Summer Transportation Institute Program - Demographics Data Sheet

State:	Montana	Project Director:	Susan Gallagher
Host Site:	Western Transportation Institute	Program Dates:	June 14-26, 2015
		Program Length:	2 weeks

Select Grade Level		Applicant Data		
High School	X	Number of Applications Received:		19
Middle School		Number of Participants Selected:		19
Select Program Classification		Number of Participants that Completed the Program:		14
Residential	X	Geographic Representation		
Non-Residential		Number of Cities: 9	Number of Counties: 7	Congressional District Number(s): Montana 1 At-large, CA 11 <sup>th</sup> District

	Race/Ethnicity							Gender		Disability	Grade Level					
	African American	Caucasian	Hispanic American	Native American	Asian American	Pacific Islander	Other	Male	Female	Targeted Disabilities*	7	8	9	10	11	12
Number Of Participants:		13	1					13	1					8	5	1
Provide Type(s) of *Targeted Disabilities: N/A																

Schools Represented	
Name/City/State	Name/City/State
Park High School/Livingston/MT	
Gardiner High School/Gardiner/MT	
Grass Range High School/Grass Range/MT	
Loyola Sacred Heart High School/Missoula/MT	
Bozeman High School/Bozeman/MT	
De La Salle High School/Concord/CA	
Batesville High School/Batesville/AR	
Monte Vista High School/Alamo/CA	
Grafton High School/Yorktown/VA	

## 12 APPENDIX C: FINANCIAL REPORT

### *National Summer Transportation Institute Program*

#### *Section III: Financial Report*

State:	Montana
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Host Site:	WTI
Fiscal Year:	2015

Categories	FHWA Funds Requested	Expended	In-Kind Contribution(s)
Personnel	\$13,885.00	\$14,863.97	\$480.00
Fringe Benefits	\$3,471.25	\$3,807.25	
Recruitment	\$800.00	\$1,000	
Contractual Services	\$1,076.36	\$2603.24	\$2,729.40
Food	\$300.00	\$111.50	
Travel	\$2,800.00	\$945.36	
Supplies	\$250.00	\$285.29	
Room & Board	\$12,200.00	\$11,166.40	
Stipends			
Direct Cost	\$34,782.61	\$34,783.01	\$3,209.40
Indirect Cost	\$5,217.39	\$5,217.45	
Totals	\$40,000.00	\$40,000.00	\$3,209.40

## 13 APPENDIX D: STI SCHEDULE

### 2015 Summer Transportation Institute at Montana State University

#### Week 1: June 15 – June 26

<p>Monday, June 15</p> <p><b>8:30-10:30am:</b> STI Orientation [WTI Classroom, Rm 333] (half hour for Pat McGowen – Future Transportation Landscape)</p> <p><b>10:30am-11:30am:</b> Road Ecology</p> <p><b>Noon-1pm:</b> Lunch (Harrison Dining Hall)</p> <p><b>1:00-2:00:</b> Campus Tour (Admissions Office, SUB, 2<sup>nd</sup> fl.)</p> <p><b>2:00-4:00pm:</b> [CB202] Structures/Bridge Design [Damon Fick]</p> <p><b>4:00-5:00pm:</b> [Tait lab] West Point Bridge design</p>	<p>Thursday, June 18</p> <p><b>8-11am:</b> Crash attenuators (Amanda Ricker) [CB202]</p> <p><b>11-noon:</b> Sub Zero lab tour (Ladean McKittrick)</p> <p><b>Noon-1pm:</b> Lunch (Harrison Dining Hall)</p> <p><b>1-2pm:</b> College Prep (Admissions office)</p> <p><b>2-5pm:</b> Balsa bridge work</p>
<p>Tuesday, June 16</p> <p><b>8-10am:</b> Balsa bridge design competition introduction [WTI classroom]</p> <p><b>10-noon:</b> Human Factors &amp; Driving Simulator (Kaysha Young)</p> <p><b>Noon-1pm:</b> Lunch (Harrison Dining Hall)</p> <p><b>1-4pm:</b> Concrete Introduction and lab; concrete testing [CB202/CB bulk materials lab] Mike Berry</p> <p><b>4-5pm:</b> Commercial vehicles [CB202] Jerry Stephens</p>	<p>Friday, June 19</p> <p><b>6:30am:</b> Breakfast and pick up sack lunches</p> <p><b>7am:</b> Depart for Tour of Montana Department of Transportation Headquarters (Helena)</p> <p><b>2pm:</b> Last Chance Gulch Train ride</p>
<p>Wednesday, June 17</p> <p><b>8am-noon:</b> Public Involvement, Context Sensitive Solutions, and what it all means (Robyn Austin, Kittleson &amp; Associates) [WTI Rm 333]</p> <p><b>Noon-1pm:</b> Lunch</p> <p><b>2-3pm:</b> Introduction to Civil and Construction Engineering [CB202] Jerry Stephens</p> <p><b>3-5pm:</b> Soil Reinforcement and Retaining Walls (Erin Hafla) [CB202]</p>	<p>Saturday/Sunday June 20-21</p> <p><b>Sports and Enhancement Activities</b></p> <p>Lewis and Clark Caverns-Saturday</p> <p>Museum of the Rockies-Sunday</p>

**Week 2: June 22 – June 26**

Monday, June 22	Thursday, June 25
<p><b>8am-9am:</b> Strong Interest Inventory- [CB Tait Lab] Career Services</p> <p><b>9am-noon:</b> Intersection counting and traffic study [Tait Lab] Pat McGowen</p> <p><b>Noon-1pm:</b> Lunch (Harrison Dining Hall)</p> <p><b>1-4pm:</b> Wetlands presentation &amp; site visit (Scott Keller) [WTI Rm 333]</p>	<p><b>8am-10am:</b> Final evaluations; transportation knowledge post-test (Jeopardy) [WTI classroom]</p> <p><b>10am-noon:</b> Test balsa bridges</p> <p><b>Noon-1pm:</b> Lunch (Harrison Dining Hall)</p> <p><b>1-2pm:</b> Glider Testing (Sturman)</p> <p><b>2-5pm:</b> Closing ceremony preparation</p>
Tuesday, June 23	Friday, June 26
<p><b>8am-noon:</b> Traffic Engineering...the Ins and Outs of Traffic Signals on Main Street (Scott Beard, Kittleson &amp; Assoc.) [WTI Rm 333]</p> <p><b>Noon-1pm:</b> Lunch (Harrison Dining Hall)</p> <p><b>1-2pm:</b> Career Planning (Career Services) [WTI classroom, Rm 333]</p> <p><b>2-5pm:</b> Livability (Kack, Gleason, Lonsdale) [WTI Classroom Rm 333]</p>	<p><b>Morning:</b> Packing and Dorm Check Out</p> <p><b>11am-Noon (WTI Classroom)</b> STI Closing Ceremony and Farewells</p>
Wednesday, June 24	
<p><b>7am:</b> Pick up picnic lunches at Harrison</p> <p><b>8:15am:</b> Depart for Gallatin Field Airport</p> <p><b>8:30am-1pm:</b> Field trip to Gallatin Field Airport and discovery flights with Summit Aviation</p> <p><b>2:00-3:00:</b> Aviation Presentation [WTI classroom]</p> <p><b>3:00-5pm:</b> Glider team design/build project (Dawn Shurman) [WTI classroom]</p>	

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