

Construction Inspector Qualification Plan



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Acknowledgements

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CHAPTER 1: Introduction

Background.

The historical method of employee development at the Colorado Department of Transportation included mentoring through on the job training. Up until the early 1990s this was a very effective method that resulted in a well-trained and qualified staff.

From the late 1980s to the mid 1990s, CDOT's budget was between \$400 to \$500 million per year and relatively stable. From the mid 1990s to the early 2000s, CDOT's budget grew to nearly \$1 billion with no increase in staff. During this time of growth, CDOT's staff could no longer deliver projects and develop employees. Employee development, as it was previously and informally known, ceased to exist. Further it became necessary to privatize and hire consultants to assist with project delivery.

Privatization had mixed results. The use of consultants to assist with project delivery was successful at allowing CDOT to advertise and construct the increased budget. Unfortunately, the consultants were often not familiar with CDOT plans, specifications, or business practices. The experienced CDOT staff was stretched too thin and was unable to provide the necessary mentoring that the consultants needed. To complicate matters, there were a large number of retirements of experienced CDOT personnel. These people were replaced with new and qualified people, but once again, these new CDOT personnel did not possess the familiarity with CDOT plans, specifications, or business practices.

Concerns continued to increase on an annual basis regarding the employee development of CDOT staff and consultants. Concerns from all parties, including industry, were reaching a peak. Industry was polite in their feedback to CDOT and began developing training programs on their own to train CDOT and consultant personnel. The Program Engineers elected to take a proactive step. At the June 3, 2003 Program Engineers' Meeting, a subcommittee was formed to develop a construction inspector qualification plan. The results of this effort are in this document.

Purpose.

To stay competitive, CDOT must put more of an emphasis on improving the overall workforce in the future. The scope of this effort was to address the construction inspector portion of the workforce. The purpose of this document is to:

- provide guidance that will be beneficial in the recruitment and development of construction inspectors,
- communicate to current staff and potential candidates for construction inspector jobs that job duties are high-tech, fun, and exciting.
- document an upward mobility plan or career path such that the initial duties are a stepping-stone to a better and more rewarding job, and
- identify that professionalism is a value within CDOT by participating in certification programs as part of a career path.

Summary of Products.

10 categories were identified for construction inspection qualification

- Basic Highway Math
- Basic Construction Surveying
- Basic Highway Plan Reading
- Basic Materials
- Excavation and Embankment Inspection
- Asphalt Paving Inspection
- Concrete Transportation Construction Inspection
- Storm Water Management and Erosion Control
- Minor Structures (Pipes)
- Major Structures (Bridges and CBC)

4 Self-study manuals were developed

- Basic Highway Math
- Basic Construction Surveying
- Basic Highway Plan Reading with sample plan sheets
- Excavation and Embankment Inspection

5 Training courses were identified

- Basic Construction Surveying (Metro State)
- Basic Materials (CDOT, CAPA, and ACI)
- Asphalt Paving Inspection (CAPA)
- Concrete Transportation Construction Inspection (ACI)
- Erosion Control and Drainage (Red Rocks Community College)

7 Refresher materials were procured

- Asphalt Paving Video (FHWA)
- Hot-Mix Asphalt Paving Handbook (AASHTO)
- Concrete Paving Video (International Road Federation)
- Asphalt and Concrete Paving CD-ROM (Washington State DOT)
- Major Structures Inspection (International Road Federation)
- Field Inspection of Reinforcing Bars (Concrete Reinforcing Steel Institute - CRSI)
- Field Inspection of Epoxy Coated Rebar (CRSI)

CHAPTER 2: Construction Inspector Qualification by Inspection Category

10 categories were identified in order for inspectors to obtain qualification. Some qualifications are mandatory and some are optional. A description of the 10 categories and the resources available to obtain qualification in each category are described in this chapter. Items listed for qualification include and are defined as:

- Introductory – Optional. Basic information and terminology is provided for those new to the area. These may generally be valuable once or twice per career for an employee.
- Training – Optional. A course designed to teach a construction inspector the information necessary to become certified.
- Certification – Mandatory. Demonstration of proficiency of the subject matter is required by passing an exam and / or performing the skills.
- Refresher – Optional. It may have been several years since the formal training or certification, so these multi-media materials (videos, DVDs, manuals, etc.) are designed to allow a quick review prior to the start of a project
- Supplemental – Optional. As a construction inspector gains seniority, there is valuable information that provides an enhanced background and a deeper understanding to the importance of the duties.

Basic Highway Math.

There is a great deal of mathematics used in the construction field. Each day the construction inspector must use arithmetic, algebraic, and geometric skills in their work. There is no introductory course and the training is available through a self-study manual. The certification is a written exam.

Qualification	Source	Media	Length	Frequency
Certification	GA DOT	Manual & Exam	61 pages	once per career

Basic Construction Surveying.

It is important for a construction inspector to understand construction staking and layout. Even if the inspector is not performing the duties of the surveyor, understanding the background is important to be competent at the job.

The training can be provided through a self-study manual or attending a training course. The certification is a written exam.

Qualification	Source	Media	Length	Frequency
Certification	WS DOT	Manual & Exam	95 pages	once per career
Training	Metro State and CDOT Construction Surveying 1	Course	1 day	once per career

Basic Highway Plan Reading.

It is important for a construction inspector to have familiarity with the plans, specifications, shop drawings, contracts, and documentation on a project. It is these documents that the inspector is verifying in the field. These are complex documents, but with training and experience, can be navigated easily to understand the intentions on the project.

The training is provided through a self-study manual. The certification is a written exam.

Qualification	Source	Media	Length	Frequency
Certification	GA DOT	Manual & Exam	46 pages	once per career

Basic Materials.

Although it is not imperative for a construction inspector to be a materials expert, understanding the most fundamental materials properties will allow a construction inspector to be more thorough and complete on the project. Some of the best construction inspectors have a very strong materials background, and vice-versa.

To gain an introduction to materials testing, the purpose of the tests, and the documentation, a 4-day introductory course is available. The certification for asphalt and concrete materials is done through a demonstration of proficiency and a written exam.

Further, as an inspector gains in seniority, a deeper understanding of the QC/QA percent within limits acceptance philosophy used, as well as the understanding of the pavement design process, will enhance the inspector's ability to perform the duties on the project.

Qualification	Source	Media	Length	Frequency
Introductory	CDOT New Tester Training	Course & Exam	4 days	once per career
Certification	LabCAT Level A	Course & Exam	1 day	once per career
Certification	ACI Field Testing Technician Grade 1	Course & Exam	1 day	once per career
Supplemental	CDOT – QC/QA	Course	1 day	1 or 2 per career
Supplemental	CDOT – Pavement Design	Course	2 days	1 or 2 per career

Excavation and Embankment Inspection.

The construction inspection and materials testing for the area of soils, including the excavation, embankment and base course, are combined together. The duties during the inspection and testing are closely related and one person can perform both duties efficiently.

The training is provided through a self-study manual. The soil testing and inspection will both be part of the Western Alliance for Quality Transportation Construction (WAQTC) program. The certification will require a demonstration of proficiency and written exam for the testing and a written exam for the inspection.

Qualification	Source	Media	Length	Frequency
Certification	GA DOT	Manual & Exam	23 pages	every 3 years
Certification	WAQTC Excavation and Embankment Inspection	Course & Exam	1 day	every 3 years

Asphalt Paving Inspection.

In order to be introduced to the equipment and processes for asphalt paving, introductory courses are available and include the Jim Scherocman training as well as the NHI Hot-Mix Asphalt Construction course. These courses provide the construction inspector with the basic operational processes of asphalt paving. Certification is required to include attendance or a course followed by a written exam as part of the Colorado Asphalt Pavement Association. This will be required every three years.

Refresher information includes a VHS video from the FHWA, the AASHTO Hot-Mix Asphalt Paving Handbook, and an interactive CD-ROM developed by the Washington State DOT. This information can be reviewed prior to the start of projects. As specifications change and require updating, each Region conducts its annual Region Materials School to allow inspectors to stay up-to-date with any specification changes.

Qualification	Source	Media	Length	Frequency
Intro.	Scherocman / NHI	Course	2 days	1 or 2 per career
Certification	CAPA Asphalt Paving Inspection Level I	Course & Exam	1 day	every 3 years
Certification	LabCAT Level A	Course & Exam	3 days	once per career
Refresher	FHWA	Video	60 minutes	prior to paving
Refresher	AASHTO	Manual	219 pages	prior to paving
Refresher	WS DOT	CD ROM		prior to paving
Refresher	Region Mat. School	Course	1 day	once per year

Concrete Transportation Construction Inspection.

In order to be introduced to the equipment and processes for concrete paving, introductory courses are available and include a CDOT training course as well as the NHI Construction of Portland Cement Concrete Pavements course. These courses provide the construction inspector with the basic operational processes of concrete paving. Mandatory certification requirements include attendance of a course followed by a written exam. There are two approved courses to choose from: one is offered by the American Concrete Institute and the other is offered by the Colorado Ready Mixed Concrete Association (CRMCA). This will be required every five years.

The ACI Concrete Transportation Construction Inspection requires 5 years of experience to become a certified inspector. Those with less than 5 years experience may become a certified inspector in training. Either the certified inspector level or the certified inspector in-training level is acceptable for CDOT projects.

Refresher information includes a VHS video from the International Road Federation, and an interactive CD-ROM developed by the Washington State DOT. This information can be reviewed prior to the start of projects. As specifications change and require updating, each Region conducts its annual Region Materials School to allow inspectors to stay up-to-date with any specification changes.

Qualification	Source	Media	Length	Frequency
Intro.	CDOT – R4	Course	1 day	1 or 2 lifetime
Intro.	NHI	Course	2 days	1 or 2 lifetime
Certification	ACI Field Testing Technician Grade 1	Course & Exam	1 day	once per career
Refresher	International Road Federation	Video	20 minutes	prior to paving
Refresher	WS DOT	CD ROM		prior to paving
Refresher	Region Mat. School	Course	1 day	once per year
Choose one of the two classes listed below:				
Certification	CRMCA Concrete Paving Inspection	Course & Exam	1 day	every 5 years
Certification	ACI Concrete Transportation Construction Inspection	Course & Exam	3.5 days	every 5 years

Storm Water Management and Erosion Control.

It is important for a construction inspector to understand the environmental considerations and impacts of the project. In following with CDOT’s environmental ethic, this background is important to be competent at the job.

The training can be provided through a self-study manual. The certification is gained by attending a course and a written exam. There is a mandatory ½ day field trip as part of the course. As specifications change and require updating, each Region conducts its annual Region Environmental Training to allow inspectors to stay up-to-date with any changing requirements.

Qualification	Source	Media	Length	Frequency
Certification	Red Rocks / CCA / Altitude Training – Stormwater Management and Erosion Control	Course & Exam	1.5 days	once per career
Reference	Region Environ. Training	Course	1 day	once per year
Reference	CDOT	Manual	100 pages	prior to project

Minor Structures (Pipes).

This is a complex category and still under development. The development will rely heavily on the Transportation Construction Curriculum Coordination effort.

Qualification	Source	Media	Length	Frequency
Certification	WS DOT	Manual & Exam	1 day	once per career
Introductory	ACPA	CD Rom	14 min	once per career

Major Structures (Bridges and CBC).

This is a complex category and still under development. The development will rely heavily on the Transportation Construction Curriculum Coordination effort.

Qualification	Source	Media	Length	Frequency
Certification	?	Course & Exam	2 to 3 days	once per career
Refresher	?	Course & Exam	1 day	as needed
Refresher	IRF	Video (structures)	56 min	
Refresher	CRSI	Video (epoxy)	8 min	prior to project
Refresher	CRSI	Video (rebar)	25 min	prior to project

CHAPTER 3: Qualification Administration

To streamline and ensure details are covered for the Inspector Qualification Program we divided the administrative and technical responsibilities as follows:

Administrative Responsibilities

The role of the construction inspection qualification program administrator will be to schedule exams, take registrations, collect fees, proctor exams, grade exams, send results to the applicants, and enter results into the training tracking database.

CDOT will administer the program. Registration fees will fund the program. Enhancements are defined as those items that go above and beyond the day-to-day administration. The funding of these enhancements will not come from the registration fees. CDOT will need to fund these changes. Examples could include the development of an eleventh certification, the start-up costs of developing a course catalogue, etc.

Exam dates can be scheduled in the Regions. It would be most beneficial in Regions 3 and 5.

Technical Responsibility

The responsibility for the technical administration includes the updating of the qualification manuals and exams. There are existing steering committees or boards of directors for asphalt, concrete, and soils testing. In order to efficiently utilize the existing structure and limited resources, it is recommended that these steering committees absorb the oversight of the basic materials, asphalt paving, concrete paving, earthwork and excavation inspection, and major structure inspection.

Category	Steering Committee	Meeting Frequency
Basic Materials	Materials Advisory Committee	
Asphalt Paving	LabCAT Board	2 times per year
Concrete Paving	CRMCA Technical Committee	
Major Structures	CRMCA Technical Committee	
Earthwork	WAQTC Board	2 times per year

Although there will be some additional responsibilities for each of these existing steering committees, it is anticipated that any additional costs will be able to be absorbed as part of a current process.

The Construction Inspection Qualification Board of Directors has been established to cover the other categories of inspection. This Board will need to

meet approximately twice per year to review to the following categories of qualification:

- Basic Highway Math
- Basic Construction Surveying
- Basic Highway Plan Reading
- Storm Water Management and Erosion Control
- Minor Structures
- Major Structures

The review will include the technical content of these categories, the success that the program is having, and the financial balance of income from registration and costs for administration.

The Board of Directors is comprised of:

- CDOT (4 members)
- Consultants (URS Corporation, Carter & Burgess, and Stantec)
- Contractors (Colorado Contractors Association)

Web Page

A web page has been developed. It can be accessed both internally and externally on the CDOT web site at:

<http://www.dot.state.co.us/CHRMEmpCorner/empdev.cfm>

The web page has links to the:

- business plan,
- self-study manuals and refresher materials,
- course catalogue with course dates, costs, and registration information,
- communications from the Chief Engineer regarding the applicability and timing for implementation, and
- list of those qualified in each category. Note: The list of those qualified in each category is only accessible through CDOT's internal network.

CHAPTER 4: Qualification Cost Estimates

Once per Career Costs for a New Employee (Funds and Days)

The days and funds that should be budgeted for items required for qualification of new employees that are needed once per career are shown in the table below. A total of 16.5 days and \$825 will be needed. These items must be completed within the first 3 to 4 years of employment.

Category	Qualification	Days	\$\$\$
Math	Exam	0.5	\$25**
Surveying	Exam	0.5	\$25**
Surveying	Course (optional)	1	\$195
Plan Reading	Exam	0.5	\$25**
Materials School	Introductory	4	0*
Materials QC/QA	Course	1	0*
Materials Pavement	Course	2	0*
Asphalt	Scherocman Course	2	0*
Asphalt	LabCAT A	1	\$200
Concrete	NHI Course	2	0*
Concrete	ACI Field 1	1	\$235
Erosion Control	Course	1	\$120
Minor Structures	Course & Exam	?	?
Totals		16.5	\$825

* these costs are already part of CDOT's training program

** these costs cover the consultant administrative costs

Once per Career Costs for an Experienced Employee (Funds and Days)

The days and funds that should be budgeted for items required for qualification of experienced employees that are needed once per career are shown in the table below. A total of 4.5 days and \$630 will be needed. These items could be completed within a one to two year window.

Category	Qualification	Days	\$\$\$
Math	Exam	0.5	\$25**
Surveying	Exam	0.5	\$25**
Plans	Exam	0.5	\$25**
Asphalt	LabCAT A	1	\$200
Concrete	ACI Field 1	1	\$235
Erosion Control	Course	1	\$120

Category	Qualification	Days	\$\$\$
Minor Structures	Course & Exam	?	?
Totals		4.5	\$630

** these costs are covered in the administrative costs listed below

Re-certification Costs (Funds and Days)

The days and funds that should be budgeted for items required for qualification of all employees and will require re-certification are shown in the table below. This is a total of 5.5 days and \$850 initially. Thereafter, a total of 1.4 days will need to be allocated on an annual basis for re-certification. Additionally, there will need to be \$217 per year allocated for the fees for re-certification.

Category	Qualification	Days	Days per Year	\$\$\$	\$ per year
Excavation / Embankment	Exam	1	0.33	200	67
Asphalt Paving	CAPA Course & Exam	1	0.33	150	50
Concrete Paving	ACI Course & Exam	3.5	0.70	500	100
Major Structure	Course & Exam	?	?	?	?
Totals		5.5	1.36	850	217

Summary of All Costs (Funds and Days)

Major and minor structures were excluded from the total cost, since they are still being developed. For an employee to achieve all levels of certification, the days and funds were calculated by adding the once per lifetime costs with the total costs for those categories requiring re-certification.

New Employees

The funds and days needed for a new employee to become qualified are listed below:

Once per career costs:	21.5 days	\$1414
Re-certification (first time) costs:	<u>5.5 days</u>	<u>\$ 850</u>
Totals:	27.0 days	\$2265

A new employee would likely take 4 to 5 years to advance to the level that all of the certifications would be required. Assuming 4 years of progression, 7 days and \$600 would need to be budgeted per year.

It should be noted that re-certification costs of 1.4 days and \$217 per year would need to be added to maintain the construction inspection qualification with the re-certification requirements.

Experienced Employees

The dollars and days needed for an experienced employee to become qualified are listed below:

Once per career costs:	4.5 days	\$ 630
Re-certification (first time) costs:	<u>5.5 days</u>	<u>\$ 850</u>
Totals:	10.0 days	\$1480

An experienced employee would likely take 2 years to obtain all of the certifications that would be required. Assuming 2 years of progression, 5 days and \$750 would need to be budgeted per year.

It should be noted that re-certification costs of 1.4 days and \$217 per year would need to be added to maintain the construction inspection qualification with the re-certification requirements.

CHAPTER 5: Gaps and Areas for Improvement

This plan was developed with limited resources: only those of the volunteer subcommittee. The subcommittee identified products that were readily available from other states and industry to develop this plan. It was recognized that there could be additional improvements to these products to further meet some specific needs within CDOT if additional resources were available. The following list of improvements is prioritized based upon the recommendation from the subcommittee.

Refresher Materials.

The videos and DVDs currently identified were considered to be the best available. The advantages of these are that no developmental resources were spent as we had no budget - we just purchased the best available. Additionally, we are getting information to our staff right now that will hopefully make a difference soon. The disadvantages are that it will be costly to get more of these multi-media tools, they do not reflect CDOT practice 100%, and they may not be in the most convenient format (VHS instead of DVD).

Depending on the feedback we get regarding these multi-media refresher tools, it is possible to work with CDOT's videographer to develop a set of CDOT DVDs on each of the categories. There will be a cost associated in development. Although a cost proposal would need to be prepared, it will very likely be affordable and well worth it. CDOT could then mass produce (at minimal cost) copies for every individual employee or Residency and have them all on the same media that is most convenient for CDOT.

Advanced Level Courses.

The basic skills needed for construction inspection have been developed. These include areas for initial training and more advanced areas that include the demonstration of proficiency. A gap identified was in the advanced training that could be offered. As an example, the asphalt paving inspection could be examined. The development of a training course for distribution of advanced information such as skills needed for paver operation and basic asphalt paving equipment requirements would add value. The most experienced CDOT asphalt paving inspectors could further enhance their skills with the appropriate advanced level course.

Ties to Promotions.

As the qualification in each of the categories is tied to promotions, there is a need for appointing authorities to quickly identify if the candidate ready for promotion is qualified. An easy method is needed. One suggestion would be to develop a

checklist that the employee would complete and sign. The supervisor would then verify and sign it as well. The appointing authority would then have a quick check that the qualifications were met.

CHAPTER 6: Construction Inspector Qualification by Class Description

10 categories were identified in order for inspectors to obtain qualification. A description of each category in relationship to the career path for those in the technical and professional class descriptions are described in this chapter. The specific requirements based on class description can be found in the Chief Engineer's Policy Memo posted on the web page.

<http://www.dot.state.co.us/CHREmpCorner/empdev.cfm>

Qualifications for the Technical Class Description.

When preparing a Personnel Description Questionnaire (PDQ) for an employee, the items listed below each class description must be included in the PDQ for that class description. The certifications are tied to promotions for the technical class description.

Engineer / Physical Sciences Assistant 1

- Minimum Qualifications listed in the Class Description required by CHRM.

Engineer / Physical Sciences Assistant 2

- Minimum Qualifications listed in the Class Description required by CHRM.
- Basic Highway Math
- Basic Construction Surveying
- Plan Reading (first chapter with self study)
- Asphalt Paving Inspection (On the Job Training - tickets, yield, temperatures, other basics)
- Concrete Transportation Construction Inspection (Apprenticeship)

Engineer / Physical Sciences Assistant 3

- Minimum Qualifications listed in the Class Description required by CHRM.
- Plan Reading
- Basic Materials
- Minor Structures
- Asphalt Paving Inspection (On the Job Training - segregation, compaction test section, roller pattern)
- Concrete Transportation Construction Inspection (Apprenticeship – checking tining, saw cutting, curing, etc.)

Engineer / Physical Sciences Technician 1

- Minimum Qualifications listed in the Class Description required by CHRM.
- Excavation and Embankment Inspection
- Asphalt Paving Inspection (fully functional)
- Concrete Transportation Construction Inspection (fully functional)

Engineer / Physical Sciences Technician 2

- Minimum Qualifications listed in the Class Description required by CHRM.
- Major Structures (Bridges and CBC) Inspection
- Storm Water and Erosion Control

Qualifications for the Professional Class Description.

For the professional series, there will likely be other areas of expertise needed. Those listed in this chapter are only related to construction inspection competencies. Because of the breadth of disciplines in the engineering area, it is not possible to tie these to promotions at this time. Many other areas such as design, materials, traffic, hydraulics, etc. need to be developed before making this a requirement.

Following is a recommended career path to provide engineers an indication if the development of their career is on the right track.

Engineer In Training 1

- Minimum Qualifications listed in the Class Description required by CHRM.

Engineer In Training 2

- Minimum Qualifications listed in the Class Description required by CHRM.
- Basic Construction Surveying
- Plan Reading
- Basic Materials
- Minor Structures

Engineer In Training 3

- Minimum Qualifications listed in the Class Description required by CHRM.
- Excavation and Embankment Inspection
- Asphalt Paving Inspection
- Concrete Transportation Construction Inspection
- Major Structures (Bridge and CBC) Inspection
- Storm Water and Erosion Control

General Comments.

When an employee is being hired from outside of CDOT, the individual may not have all of the requirements for the level that at which they are being hired. Provisions should allow an employee reasonable time to gain the qualifications (perhaps 6 months) after being hired.

When an employee is transferring from one specialty to another, the employee may not have all of the necessary requirements to perform the new job duties. In

these cases, an employee needs to career plan in advance and gain the qualifications prior to transferring.

CHAPTER 7: Implementation Considerations

The goal is to have eight of the ten categories available for staff to begin to take. After they are available for approximately one year, they would become requirements on projects.

The details of the implementation are also described in the Chief Engineer's Policy Memo at:

<http://www.dot.state.co.us/CHREmpCorner/empdev.cfm>

CHAPTER 8: Future Considerations

This development program will allow those currently employed by CDOT and those soon to be hired by CDOT to have an understanding of the expectations to be competent at their job. Further, it will help in recruiting new hires, as they will understand the career path and expectations for promotions. One concern still exists: where will the new staff come from? There is generally not a lot of interest expressed by those in grade school and high school about the construction industry.

In order to assist in developing a pool of available candidates, it was desired to explore the development of a program at a community college. The Georgia DOT has successfully used this. Further, the Colorado Contractor's Association has developed a community college program for those in trades (iron workers, concrete finishers, etc.) and it has been considered very successful. Discussions with CDOT, CCA, Colorado Asphalt Pavement Association, and Colorado Ready Mixed Concrete Association have expressed a positive desire in working together to develop this program.

The development of a community college program to gear high school graduates to materials testing and construction inspection will be an ongoing effort in the near future.