Thinking Portable

Why and how to make your C++ cross platform

Jason Turner

- http://chaiscript.com
- http://cppbestpractices.com
- http://github.com/lefticus
- http://cppcast.com
- @lefticus
- Independent contractor

ChaiScript

```
int dosomething(int x, int y,
                const std::function<int (int, int)> &f)
{ return f(x*2, 3); }

int main()
{
  using namespace chaiscript;

  ChaiScript chai(chaiscript::Std_Lib::library());
  chai.add(fun(&dosomething), "dosomething");
  auto i = chai.eval<int>("dosomething(4,3, `+`)"); // i = 11
}
```

All my C++ has been cross-platform

- Linux i386
- Linux x86_64
- Linux MIPS
- Linux ARM
- Win32 gcc/msvc
- Win64 gcc/msvc
- MacOS i386
- MacOS x86_64
- Solaris Sparc
- FreeBSD
- Haiku

Regular Cross-platform Releases

- Last 5 years spent contracting with a team making regular (bi-weekly) releases of desktop applications
- MacOS / Linux / Windows
- Must be easy to install, usable and feel natural on native OS
- Also deploys ruby bindings for C++ libraries on all OSes

- I’m here to convince you to make all of your C++ applications cross platform
- Help you convince your co-workers
- Give some practical advice on how

Cross Platform Code is Better!

- More standards compliant
- Safer
- Future resistant
- More organized
- More tools available
- Wider customer base

Cross Platform Code is Better!

- More standards compliant
- Safer
- Future resistant

These three come with using compilers from multiple vendors on multiple platforms

More Standards Compliant

```
#include <Windows.h>
#include <iostream>

int main()
{
  BOOL b = true;

  if (b) {
    std::cout << "true";
    ++b;

  }
}
```

More Standards Compliant

```
~~#include <Windows.h>~~
#include <iostream>

int main()
{
  ~~BOOL~~ bool b = true;

  if (b) {
    std::cout << "true";
    ++b;

  }
}
```

More Standards Compliant

```
~~#include <Windows.h>~~
#include <iostream>

int main()
{
  ~~BOOL~~ bool b = true;

  if (b) {
    std::cout << "true";
    ++b;  9 : warning: incrementing expression of type bool is deprecated [-
Wdeprecated-increment-bool]  (-Weverything on clang)
  }
}
```

More Standards Compliant

- Only clang on non-Windows would find all of the portability and semantic issues in this code.

Safer

```
if (Hex_()) {
  std::string match(start, m_input_pos);
  m_match_stack.emplace_back(
    make_node<eval::Int_AST_Node>(
      std::move(match),
      prev_line,
      prev_col,
      buildInt(std::hex, match)));
  return true;
}
```

Safer

```
if (Hex_()) {
  std::string match(start, m_input_pos);
  m_match_stack.emplace_back(
    make_node<eval::Int_AST_Node>(
      std::move(match),
      prev_line,
      prev_col,
      buildInt(std::hex, match)));
  return true;
}
```

Safer

- Clang on Linux crashes, no other tool even generated a warning.

Safer http://googleresearch.blogspot.no/2006/06/extra-extra-read-all-about-it-nearly.html

```
uint64_t binarySearch(const std::vector <int64_t> &v, int64_t key) {
  int low = 0;
  int high = v.size() - 1;

  while (low <= high) {
    int mid = (low + high) / 2;
    int midVal = v[mid];

    if (midVal < key)
      low = mid + 1;
    else if (midVal > key)
      high = mid - 1;
    else
      return mid; // key found
  }
  return -(low + 1); // key not found.
}
```

Safer http://googleresearch.blogspot.no/2006/06/extra-extra-read-all-about-it-nearly.html

```
uint64_t binarySearch(const std::vector <int64_t> &v, int64_t key) {
  int low = 0;
  int high = v.size() - 1;       // No warnings on GCC at any level

  while (low <= high) {
    int mid = (low + high) / 2;
    int midVal = v[mid];         // What happens with > 2B objects?

    if (midVal < key)
      low = mid + 1;
    else if (midVal > key)
      high = mid - 1;
    else
      return mid; // key found
  }
  return -(low + 1); // key not found.
}
```

Safer http://googleresearch.blogspot.no/2006/06/extra-extra-read-all-about-it-nearly.html

```
uint64_t binarySearch(const std::vector <int64_t> &v, int64_t key) {
  int low = 0;
  int high = v.size() - 1;     !!warning: implicit conversion loses integer precision: 'unsigned long' to 'int'
                               [-Wshorten-64-to-32] clang -Weverything
  while (low <= high) {
    int mid = (low + high) / 2;
    int midVal = v[mid];

    if (midVal < key)
      low = mid + 1;
    else if (midVal > key)
      high = mid - 1;
    else
      return mid; // key found
  }
  return -(low + 1); // key not found.
}
```

Safer http://googleresearch.blogspot.no/2006/06/extra-extra-read-all-about-it-nearly.html

```
uint64_t binarySearch(const std::vector <int64_t> &v, int64_t key) {
  int low = 0;
  int high = v.size() - 1;
```

warning C4267: 'initializing': conversion from 'size_t' to 'int', possible loss of data (MSVC /W3)

```
  while (low <= high) {
    int mid = (low + high) / 2;
    int midVal = v[mid];

    if (midVal < key)
      low = mid + 1;
    else if (midVal > key)
      high = mid - 1;
    else
      return mid; // key found
  }
  return -(low + 1); // key not found.
}
```

Safer

- GCC never warns on integer sizing problems
- Clang only warns at the -Weverything level
- MSVC warns at the fairly normal /W3 level

This is a big annoyance for users porting to 64bit MSVC, but it's a real issue!

Future Resistant

```
// Not all compilers enforce all of the standard
void dosomething(std::string &t_str)
{ t_str = "code"; }

int main()
{
  dosomething(std::string("data"));
}
```

Future Resistant (real world example)

```
// Not all compilers enforce all of the standard
void dosomething(std::string &t_str)
{ t_str = "code"; }

int main()
{
  dosomething(std::string("data")); // Compiles ONLY on MSVC
}
// Generates a warning only on /W4 or higher
```

Future Resistant

- Only MSVC allows non-const reference to temporary.
- MSVC only warns all the up at /W4 level

Doing this is almost certainly a logic error, and is definitely a portability problem

More Organized

- OS specific code logically separated
- Leads to natural library / UI separation

More Tools Available

- PVS Studio (Windows Only)
- ReSharper C++ (Windows Only)
- Valgrind (Linux / MacOS Only)
- MSVC Static Analyzer (Windows Only)
- Clang's "sanitizers" (Linux is easiest)

Static Analysis (from ChaiScript)

```
template<typename T, typename U>
static Boxed_Value go(Operators::Opers t_oper, const T &t, const U &u, const Boxed_Value &) {
  switch (t_oper) {
    case Operators::equals:                return const_var(t == u);
    case Operators::less_than:             return const_var(t < u);
    case Operators::greater_than:          return const_var(t > u);
    case Operators::less_than_equal:       return const_var(t <= u);
    case Operators::greater_than_equal:    return const_var(t >= u);
    case Operators::not_equal:             return const_var(t != u);
    default:                               throw chaiscript::detail::exception::bad_any_cast();

  }
  throw chaiscript::detail::exception::bad_any_cast();
}
```

Static Analysis (from ChaiScript)

```
template<typename T, typename U>
static Boxed_Value go(Operators::Opers t_oper, const T &t, const U &u, const Boxed_Value &) {
  switch (t_oper) {
    case Operators::equals:               return const_var(t == u);
    case Operators::less_than:            return const_var(t < u);
    case Operators::greater_than:         return const_var(t > u);
    case Operators::less_than_equal:      return const_var(t <= u);
    case Operators::greater_than_equal:   return const_var(t >= u);
    case Operators::not_equal:            return const_var(t != u);
    default:                              throw chaiscript::detail::exception::bad_any_cast();

  }
  ~~throw chaiscript::detail::exception::bad_any_cast();~~ // caught by MSVC only
}
```

Static Analysis

```c
int main(int argc, char *[]) {
  if (argc > 3) {
    return 5;
  } else {
    return 5;
  }
}
```

Static Analysis

```
int main(int argc, char *[]) {
  if (argc > 3) {
    return 5;
  } else {
    return 5;
  }
}
```

```
[testcppcheck.cpp:5] -> [testcppcheck.cpp:3]: (style, inconclusive)
Found duplicate branches for 'if' and 'else'.
```

Wider Customer Base

- iOS
- Android
- Linux
- MacOS
- Windows
- Humble Bundle
- SteamOS

Guidelines - Build Tool

DRY – Don't Repeat Yourself

- Maintaining multiple project files for multiple build configurations is hard. Let a build tool / makefile generator do the work for you

Guidelines - Build Tool

- CMake
- biicode
- qmake
- premake
- meson
- Others here at the conference?

Guidelines - Choose Your Compilers

- Choose which compilers and how old you’ll support
- VS 2013 has limited C++11 support (constexpr, nothrow, defaulted functions, magic statics...)
- GCC 4.6 warns on return type deduction of complex lambdas
- And other issues

Guidelines - Choose Your Compilers

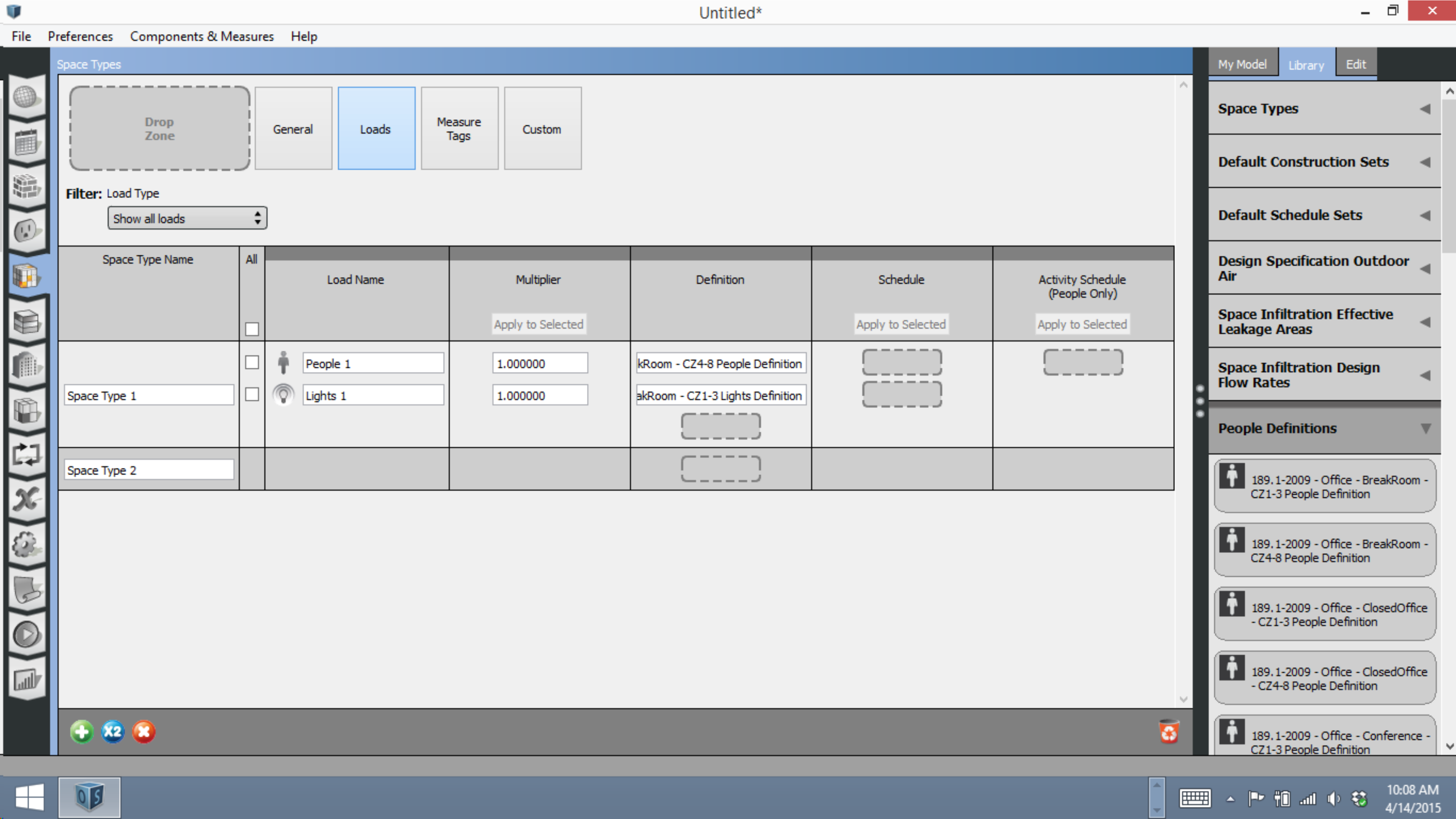
```
#ifndef CHAISCRIPT_MSVC_12
#define CHAISCRIPT_HAS_MAGIC_STATICS
#endif

#if (defined(__GNUC__) && __GNUC__ > 4) || (__GNUC__ == 4 && __GNUC_MINOR__
>= 7) || defined(CHAISCRIPT_MSVC) || defined(__llvm__)
#define CHAISCRIPT_OVERRIDE override
#else
#define CHAISCRIPT_OVERRIDE
#endif

#ifdef CHAISCRIPT_MSVC
#define CHAISCRIPT_NOEXCEPT throw()
#define CHAISCRIPT_CONSTEXPR
#else
#define CHAISCRIPT_NOEXCEPT noexcept
#define CHAISCRIPT_CONSTEXPR constexpr
#endif
```

Guidelines - GUI Toolkit

- Native?
- wxWidgets
- gtkmm
- FLTK
- Qt



Filter: Load Type

Show all loads

Space Type Name	All	Load Name	Multiplier	Definition	Schedule	Activity Schedule (People Only)
	☐		Apply to Selected		Apply to Selected	Apply to Selected
Space Type 1	☐	People 1	1.000000	kRoom - CZ4-8 People Definition		
	☐	Lights 1	1.000000	akRoom - CZ1-3 Lights Definition		
Space Type 2						

Space Types

Default Construction Sets

Default Schedule Sets

Design Specification Outdoor Air

Space Infiltration Effective Leakage Areas

Space Infiltration Design Flow Rates

People Definitions

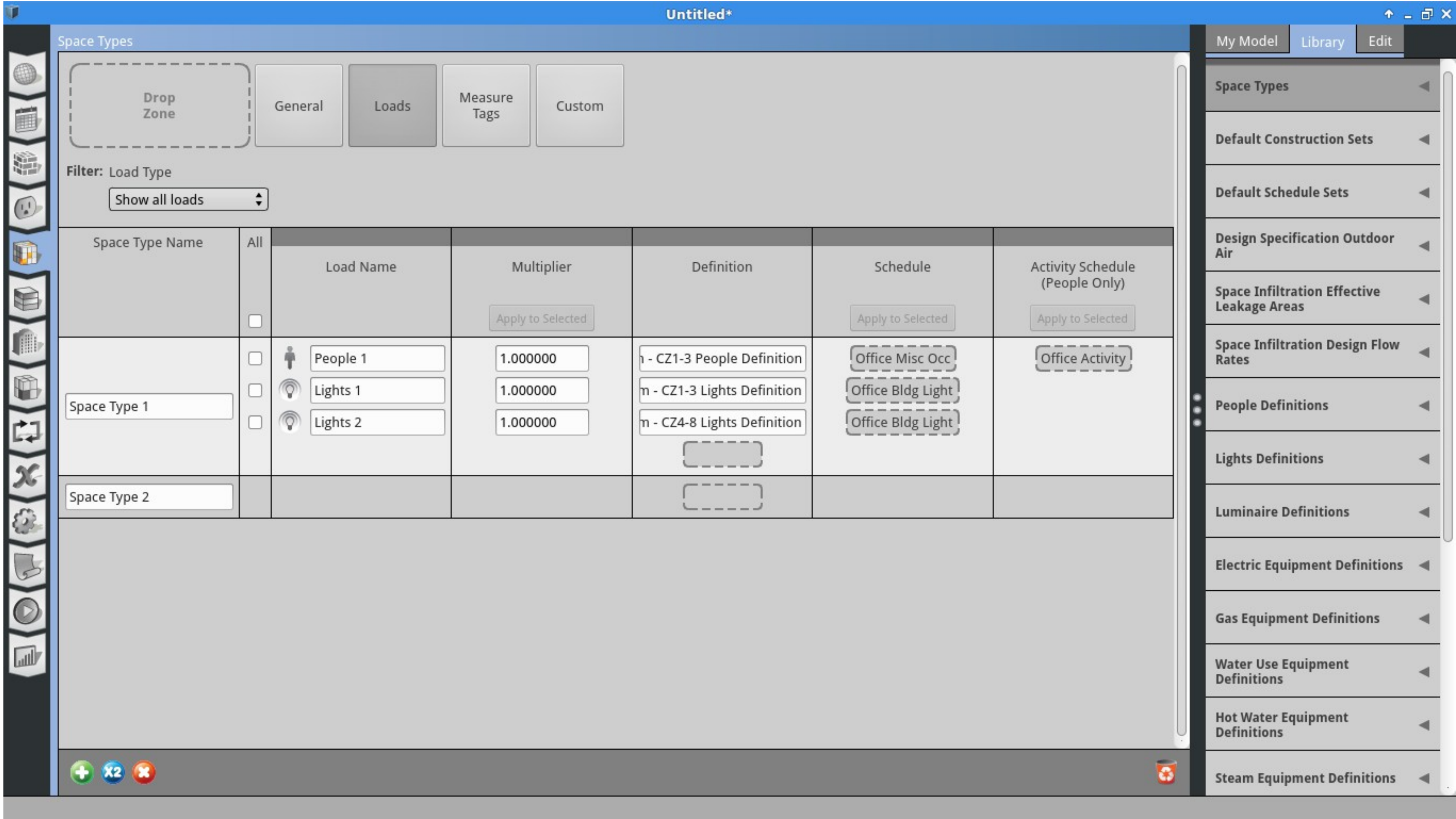
189.1-2009 - Office - BreakRoom - CZ1-3 People Definition

189.1-2009 - Office - BreakRoom - CZ4-8 People Definition

189.1-2009 - Office - ClosedOffice - CZ1-3 People Definition

189.1-2009 - Office - ClosedOffice - CZ4-8 People Definition

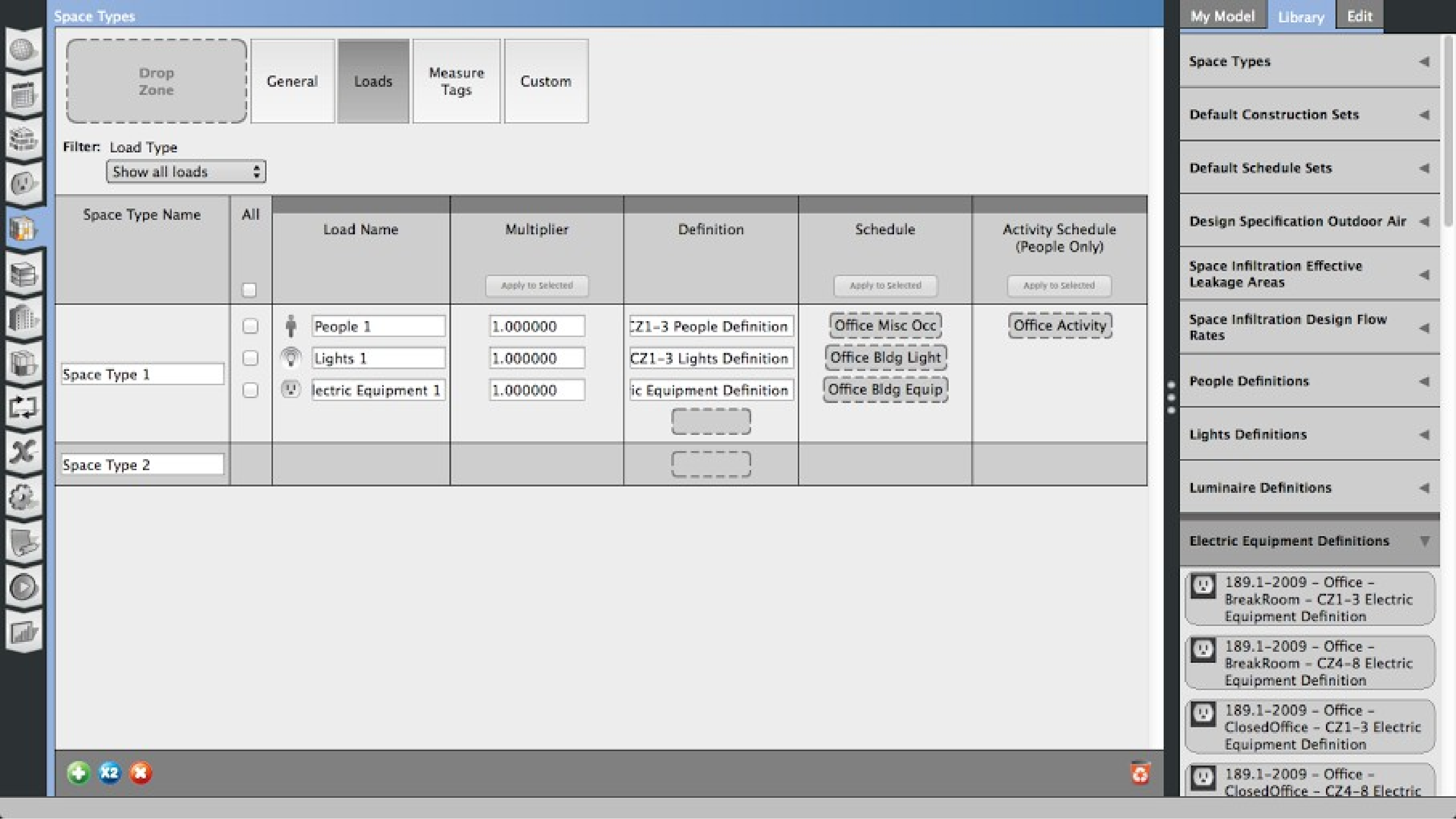
189.1-2009 - Office - Conference - CZ1-3 People Definition


Untitled*
Space Types
Drop Zone
General
Loads
Measure Tags
Custom
My Model
Library
Edit
Space Types
Default Construction Sets
Default Schedule Sets
Design Specification Outdoor Air
Space Infiltration Effective Leakage Areas
Space Infiltration Design Flow Rates
People Definitions
Lights Definitions
Luminaire Definitions
Electric Equipment Definitions
Gas Equipment Definitions
Water Use Equipment Definitions
Hot Water Equipment Definitions
Steam Equipment Definitions

Filter: Load Type

Show all loads

Space Type Name	All	Load Name	Multiplier	Definition	Schedule	Activity Schedule (People Only)
	☐		Apply to Selected		Apply to Selected	Apply to Selected
Space Type 1	☐	People 1	1.000000	- CZ1-3 People Definition	Office Misc Occ	Office Activity
	☐	Lights 1	1.000000	n - CZ1-3 Lights Definition	Office Bldg Light	
	☐	Lights 2	1.000000	n - CZ4-8 Lights Definition	Office Bldg Light	
Space Type 2						


Space Types

My Model | Library | Edit

Drop Zone | General | Loads | Measure Tags | Custom

Filter: Load Type
Show all loads

Space Type Name	All	Load Name	Multiplier	Definition	Schedule	Activity Schedule (People Only)
	☐		Apply to Selected		Apply to Selected	Apply to Selected
Space Type 1	☐	People 1	1.000000	:Z1-3 People Definition	Office Misc Occ	Office Activity
	☐	Lights 1	1.000000	CZ1-3 Lights Definition	Office Bldg Light	
	☐	lectric Equipment 1	1.000000	ic Equipment Definition	Office Bldg Equip	
Space Type 2						

Space Types
Default Construction Sets
Default Schedule Sets
Design Specification Outdoor Air
Space Infiltration Effective Leakage Areas
Space Infiltration Design Flow Rates
People Definitions
Lights Definitions
Luminaire Definitions
Electric Equipment Definitions
189.1-2009 - Office - BreakRoom - CZ1-3 Electric Equipment Definition
189.1-2009 - Office - BreakRoom - CZ4-8 Electric Equipment Definition
189.1-2009 - Office - ClosedOffice - CZ1-3 Electric Equipment Definition
189.1-2009 - Office - ClosedOffice - CZ4-8 Electric

Guidelines - Filesystem Access

- Qt
- wxWidgets
- Boost (>255 length issue?)
- Wait for C++1z?
- Roll your own (keep it as high level as possible)

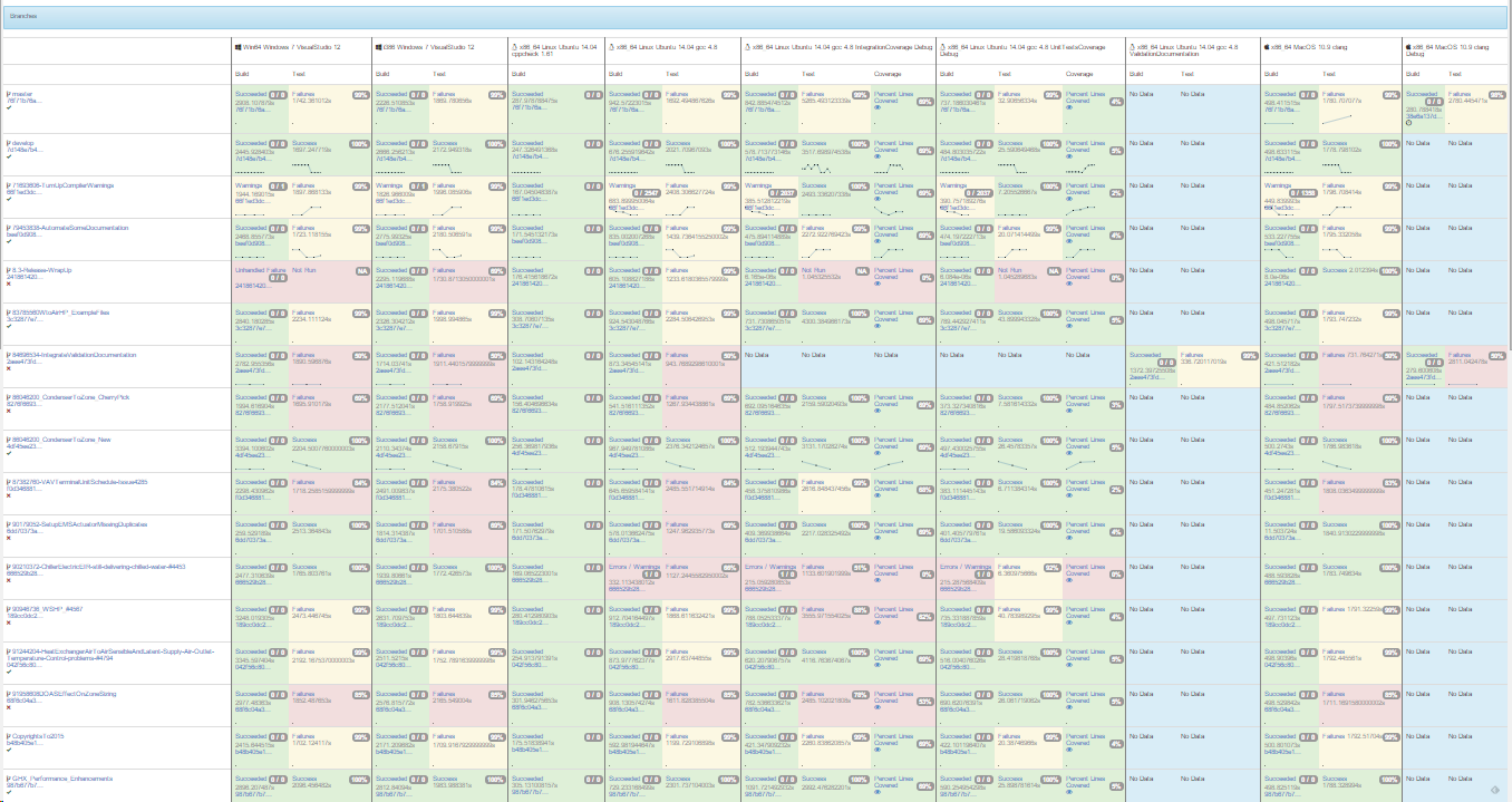
Guidelines - Automated Builds

You will never maintain cross platform capability without automated builds

- TravisCI (http://travis-ci.org, Linux)
- AppVeyor (http://appveyor.com, Windows)
- Hudson / Jenkins etc
- DecentCI (http://github.com/lefticus/decent_ci)

Full Dashboard / Active Dashboard

Dashboard for NREL/EnergyPlus



Branches

	Win64 Windows 7 VisualStudio 12		i386 Windows 7 VisualStudio 12		x86_64 Linux Ubuntu 14.04 cppcheck 1.61	x86_64 Linux Ubuntu 14.04 gcc 4.8		x86_64 Linux Ubuntu 14.04 gcc 4.8 IntegrationCoverage Debug			x86_64 Linux Ubuntu 14.04 gcc 4.8 UnitTestsCoverage Debug			x86_64 Linux Ubuntu 14.04 gcc 4.8 ValidationDocumentation		x86_64 MacOS 10.9 clang		x86_64 MacOS 10.9 clang Debug	
	Build	Test	Build	Test	Build	Build	Test	Build	Test	Coverage	Build	Test	Coverage	Build	Test	Build	Test	Build	Test
master 78f71b78a... ✓	Succeeded 0 / 0 2908.107879s 78f71b78a...	Failures 99% 1742.381012s	Succeeded 0 / 0 2226.510853s 78f71b78a...	Failures 99% 1869.780856s	Succeeded 0 / 0 287.978788475s 78f71b78a...	Succeeded 0 / 0 942.5722301s 78f71b78a...	Failures 99% 1692.494867626s	Succeeded 0 / 0 842.885474512s 78f71b78a...	Failures 99% 5285.493123339s	Percent Lines Covered 60%	Succeeded 0 / 0 737.188030461s 78f71b78a...	Failures 99% 32.90856334s	Percent Lines Covered 4%	No Data	No Data	Succeeded 0 / 0 498.411515s 78f71b78a...	Failures 99% 1780.707077s	Succeeded 0 / 0 283.788478s 35e6e137d...	Failures 99% 2780.445471s
develop 7d148a7b4... ✓	Succeeded 0 / 0 2445.928403s 7d148a7b4...	Success 100% 1897.247719s	Succeeded 0 / 0 2888.298213s 7d148a7b4...	Success 100% 2172.949318s	Succeeded 0 / 0 247.328491388s 7d148a7b4...	Succeeded 0 / 0 876.255916842s 7d148a7b4...	Success 100% 2021.70987033s	Succeeded 0 / 0 578.713773145s 7d148a7b4...	Success 100% 3517.898974533s	Percent Lines Covered 60%	Succeeded 0 / 0 484.803035722s 7d148a7b4...	Success 100% 25.590849489s	Percent Lines Covered 5%	No Data	No Data	Succeeded 0 / 0 498.833115s 7d148a7b4...	Success 100% 1778.798102s	No Data	No Data
71893808-TurnUpCompilerWarnings 88f1ad3dc... ✓	Warnings 0 / 1 1944.189015s 88f1ad3dc...	Failures 99% 1897.888133s	Warnings 0 / 1 1826.988009s 88f1ad3dc...	Failures 99% 1998.085908s	Succeeded 0 / 0 187.045048387s 88f1ad3dc...	Warnings 0 / 2547 883.832250384s 88f1ad3dc...	Failures 99% 2408.308827724s	Warnings 0 / 2037 385.512812219s 88f1ad3dc...	Success 100% 2423.336207338s	Percent Lines Covered 60%	Warnings 0 / 2037 390.757180276s 88f1ad3dc...	Success 100% 7.205528887s	Percent Lines Covered 2%	No Data	No Data	Warnings 0 / 1358 449.839923s 88f1ad3dc...	Failures 99% 1798.708414s	No Data	No Data
79453838-AutomateSomeDocumentation baef0d908... ✓	Succeeded 0 / 0 2488.855773s baef0d908...	Failures 99% 1723.118155s	Succeeded 0 / 0 2775.99325s baef0d908...	Failures 99% 2180.508591s	Succeeded 0 / 0 171.54513273s baef0d908...	Succeeded 0 / 0 835.002007288s baef0d908...	Failures 99% 1439.7384155250002s	Succeeded 0 / 0 475.894114888s baef0d908...	Failures 99% 2272.922789423s	Percent Lines Covered 60%	Succeeded 0 / 0 474.19722271s baef0d908...	Failures 99% 20.071414499s	Percent Lines Covered 4%	No Data	No Data	Succeeded 0 / 0 533.22775s baef0d908...	Failures 99% 1795.332058s	No Data	No Data
8.3-Release-WrapUp 241881420... ✗	Unhandled Failure 0 / 0 241881420...	Not Run NA	Succeeded 0 / 0 2295.119888s 241881420...	Failures 99% 1730.8713050000001s	Succeeded 0 / 0 176.415818672s 241881420...	Succeeded 0 / 0 805.108827188s 241881420...	Failures 99% 1233.8180385579999s	Succeeded 0 / 0 8.185e-06s 241881420...	Not Run NA 1.045325532s	Percent Lines Covered 0%	Succeeded 0 / 0 8.054e-06s 241881420...	Not Run NA 1.045289853s	Percent Lines Covered 0%	No Data	No Data	Succeeded 0 / 0 8.0e-06s 241881420...	Success 100% 2.012394s	No Data	No Data
83785560WtoAirHP_ExampleFiles 3c3287?e7... ✓	Succeeded 0 / 0 2840.180285s 3c3287?e7...	Failures 99% 2234.111124s	Succeeded 0 / 0 2326.304212s 3c3287?e7...	Failures 99% 1998.994985s	Succeeded 0 / 0 308.70807135s 3c3287?e7...	Succeeded 0 / 0 924.543048788s 3c3287?e7...	Failures 99% 2284.508426063s	Succeeded 0 / 0 731.70088501s 3c3287?e7...	Success 100% 4300.384988173s	Percent Lines Covered 60%	Succeeded 0 / 0 789.442927411s 3c3287?e7...	Success 100% 43.899943328s	Percent Lines Covered 5%	No Data	No Data	Succeeded 0 / 0 498.045717s 3c3287?e7...	Failures 99% 1793.747232s	No Data	No Data
84898534-IntegrateValidationDocumentation 2aee473fd... ✗	Succeeded 0 / 0 2782.955356s 2aee473fd...	Failures 98% 1890.598878s	Succeeded 0 / 0 1714.03741s 2aee473fd...	Failures 98% 1911.4401579999999s	Succeeded 0 / 0 102.143184248s 2aee473fd...	Succeeded 0 / 0 873.34545141s 2aee473fd...	Failures 98% 943.7669298810001s	No Data	No Data	No Data	No Data	No Data	No Data	Succeeded 0 / 0 1372.39725539s 2aee473fd...	Failures 99% 336.720117019s	Succeeded 0 / 0 421.512182s 2aee473fd...	Failures 731.784271s 98%	Succeeded 0 / 0 279.800939s 2aee473fd...	Failures 98% 2811.042478s
88046200_CondenserToZone_CherryPick 827878893... ✗	Succeeded 0 / 0 1894.816804s 827878893...	Failures 98% 1895.910179s	Succeeded 0 / 0 2177.512041s 827878893...	Failures 98% 1758.919925s	Succeeded 0 / 0 156.404898834s 827878893...	Succeeded 0 / 0 541.516111352s 827878893...	Failures 98% 1267.934438881s	Succeeded 0 / 0 892.095184835s 827878893...	Success 100% 2159.59020493s	Percent Lines Covered 60%	Succeeded 0 / 0 373.327340816s 827878893...	Success 100% 7.581614332s	Percent Lines Covered 3%	No Data	No Data	Succeeded 0 / 0 484.852062s 827878893...	Failures 98% 1797.5173799999999s	No Data	No Data
88046200_CondenserToZone_New 4df45ae23... ✓	Succeeded 0 / 0 3394.100802s 4df45ae23...	Success 100% 2204.5007780000003s	Succeeded 0 / 0 2110.34374s 4df45ae23...	Success 100% 2158.67915s	Succeeded 0 / 0 256.389817036s 4df45ae23...	Succeeded 0 / 0 987.949781085s 4df45ae23...	Success 100% 2378.342124857s	Succeeded 0 / 0 512.193944743s 4df45ae23...	Success 100% 3131.1702827s	Percent Lines Covered 60%	Succeeded 0 / 0 497.430025755s 4df45ae23...	Success 100% 28.4578335?s	Percent Lines Covered 5%	No Data	No Data	Succeeded 0 / 0 500.2743s 4df45ae23...	Success 100% 1788.983618s	No Data	No Data
87382760-VAVTerminalUnitSchedule-Issue4285 f0d348881... ✗	Succeeded 0 / 0 2298.430982s f0d348881...	Failures 84% 1718.2585159999999s	Succeeded 0 / 0 2491.009837s f0d348881...	Failures 84% 2175.380522s	Succeeded 0 / 0 178.478108?5s f0d348881...	Succeeded 0 / 0 845.856584145s f0d348881...	Failures 84% 2485.551714914s	Succeeded 0 / 0 458.375810895s f0d348881...	Failures 99% 2816.84843?456s	Percent Lines Covered 60%	Succeeded 0 / 0 383.111445143s f0d348881...	Success 100% 6.711384314s	Percent Lines Covered 2%	No Data	No Data	Succeeded 0 / 0 451.247281s f0d348881...	Failures 83% 1808.0383499999999s	No Data	No Data
90179052-SetupEMSActuatorMissingDuplicates 8dd70373a... ✗	Succeeded 0 / 0 259.529185s 8dd70373a...	Success 100% 2513.384843s	Succeeded 0 / 0 1814.314387s 8dd70373a...	Failures 98% 1701.510588s	Succeeded 0 / 0 171.50782?9s 8dd70373a...	Succeeded 0 / 0 578.013892475s 8dd70373a...	Failures 98% 1247.982205773s	Succeeded 0 / 0 409.389338894s 8dd70373a...	Success 100% 2217.028325492s	Percent Lines Covered 60%	Succeeded 0 / 0 401.405779787s 8dd70373a...	Success 100% 19.588393324s	Percent Lines Covered 4%	No Data	No Data	Succeeded 0 / 0 11.503724s 8dd70373a...	Success 100% 1840.9130299999999s	No Data	No Data
90210372-ChillerElectricEIR-still-delivering-chilled-water-#4453 888529b28... ✗	Succeeded 0 / 0 2477.310839s 888529b28...	Success 100% 1765.803761s	Succeeded 0 / 0 1939.80881s 888529b28...	Success 100% 1772.428573s	Succeeded 0 / 0 169.085229001s 888529b28...	Errors / Warnings 1 / 0 332.113438072s 888529b28...	Failures 66% 1127.2445592950002s	Errors / Warnings 1 / 0 215.092283853s 888529b28...	Failures 51% 1133.801901999s	Percent Lines Covered 0%	Errors / Warnings 1 / 0 215.287584?8s 888529b28...	Failures 92% 6.389975999s	Percent Lines Covered 0%	No Data	No Data	Succeeded 0 / 0 488.593828s 888529b28...	Success 100% 1783.749834s	No Data	No Data
90946738_WSHP_#4567 189cc0dc2... ✗	Succeeded 0 / 0 3248.019305s 189cc0dc2...	Failures 99% 2473.446745s	Succeeded 0 / 0 2631.709753s 189cc0dc2...	Failures 99% 1803.844839s	Succeeded 0 / 0 280.412980303s 189cc0dc2...	Succeeded 0 / 0 912.704184487s 189cc0dc2...	Failures 99% 1868.811632421s	Succeeded 0 / 0 788.052533377s 189cc0dc2...	Failures 88% 3555.971554025s	Percent Lines Covered 62%	Succeeded 0 / 0 735.331887859s 189cc0dc2...	Failures 99% 40.783892295s	Percent Lines Covered 4%	No Data	No Data	Succeeded 0 / 0 497.731123s 189cc0dc2...	Failures 1791.32259s 99%	No Data	No Data
91244204-HeatExchangerAirToAirSensibleAndLatent-Supply-Air-Outlet-Temperature-Control-problems-#4794 042f56c80... ✓	Succeeded 0 / 0 3345.597404s 042f56c80...	Failures 99% 2192.1875370000003s	Succeeded 0 / 0 2511.5215s 042f56c80...	Failures 99% 1752.7891639999999s	Succeeded 0 / 0 254.913791391s 042f56c80...	Succeeded 0 / 0 873.977782377s 042f56c80...	Failures 99% 2917.83744855s	Succeeded 0 / 0 820.207906757s 042f56c80...	Success 100% 4116.783874087s	Percent Lines Covered 60%	Succeeded 0 / 0 516.004078026s 042f56c80...	Success 100% 28.419818789s	Percent Lines Covered 5%	No Data	No Data	Succeeded 0 / 0 498.90398s 042f56c80...	Failures 99% 1792.445581s	No Data	No Data
91958808DOASEffectOnZoneSizing 88f8c04a3... ✗	Succeeded 0 / 0 2977.48363s 88f8c04a3...	Failures 85% 1852.487853s	Succeeded 0 / 0 2578.815772s 88f8c04a3...	Failures 85% 2165.549004s	Succeeded 0 / 0 301.948275853s 88f8c04a3...	Succeeded 0 / 0 908.130574274s 88f8c04a3...	Failures 85% 1811.828385504s	Succeeded 0 / 0 782.538838821s 88f8c04a3...	Failures 79% 2485.102021808s	Percent Lines Covered 53%	Succeeded 0 / 0 690.820783?s 88f8c04a3...	Success 100% 28.081719082s	Percent Lines Covered 5%	No Data	No Data	Succeeded 0 / 0 498.528842s 88f8c04a3...	Failures 85% 1711.1691580000002s	No Data	No Data
CopyrightsTo2015 b48b405e1... ✓	Succeeded 0 / 0 2415.844515s b48b405e1...	Failures 99% 1702.124117s	Succeeded 0 / 0 2171.209882s b48b405e1...	Failures 99% 1709.9167029999999s	Succeeded 0 / 0 175.515839?1s b48b405e1...	Succeeded 0 / 0 592.981944847s b48b405e1...	Failures 99% 1199.729108898s	Succeeded 0 / 0 421.347909232s b48b405e1...	Failures 99% 2280.838620857s	Percent Lines Covered 60%	Succeeded 0 / 0 422.101198407s b48b405e1...	Failures 99% 20.38748989s	Percent Lines Covered 4%	No Data	No Data	Succeeded 0 / 0 500.801073s b48b405e1...	Failures 1792.51704s 99%	No Data	No Data
GHX_Performance_Enhancements 98fb67fb7... ✓	Succeeded 0 / 0 2898.207467s 98fb67fb7...	Success 100% 2098.458482s	Succeeded 0 / 0 2812.84094s 98fb67fb7...	Success 100% 1983.988381s	Succeeded 0 / 0 305.131008157s 98fb67fb7...	Succeeded 0 / 0 729.233168489s 98fb67fb7...	Success 100% 2301.737104003s	Succeeded 0 / 0 1091.721492932s 98fb67fb7...	Success 100% 2992.476262201s	Percent Lines Covered 60%	Succeeded 0 / 0 590.254854298s 98fb67fb7...	Success 100% 25.898781814s	Percent Lines Covered 5%	No Data	No Data	Succeeded 0 / 0 498.825119s 98fb67fb7...	Success 100% 1788.328694s	No Data	No Data

How To Convince Your Team

- Show them the examples from these slides
- Try to extract some core functionality
- Set up a CMake stub to compile the core
- Demonstrate a tangible benefit from what the new compiler finds

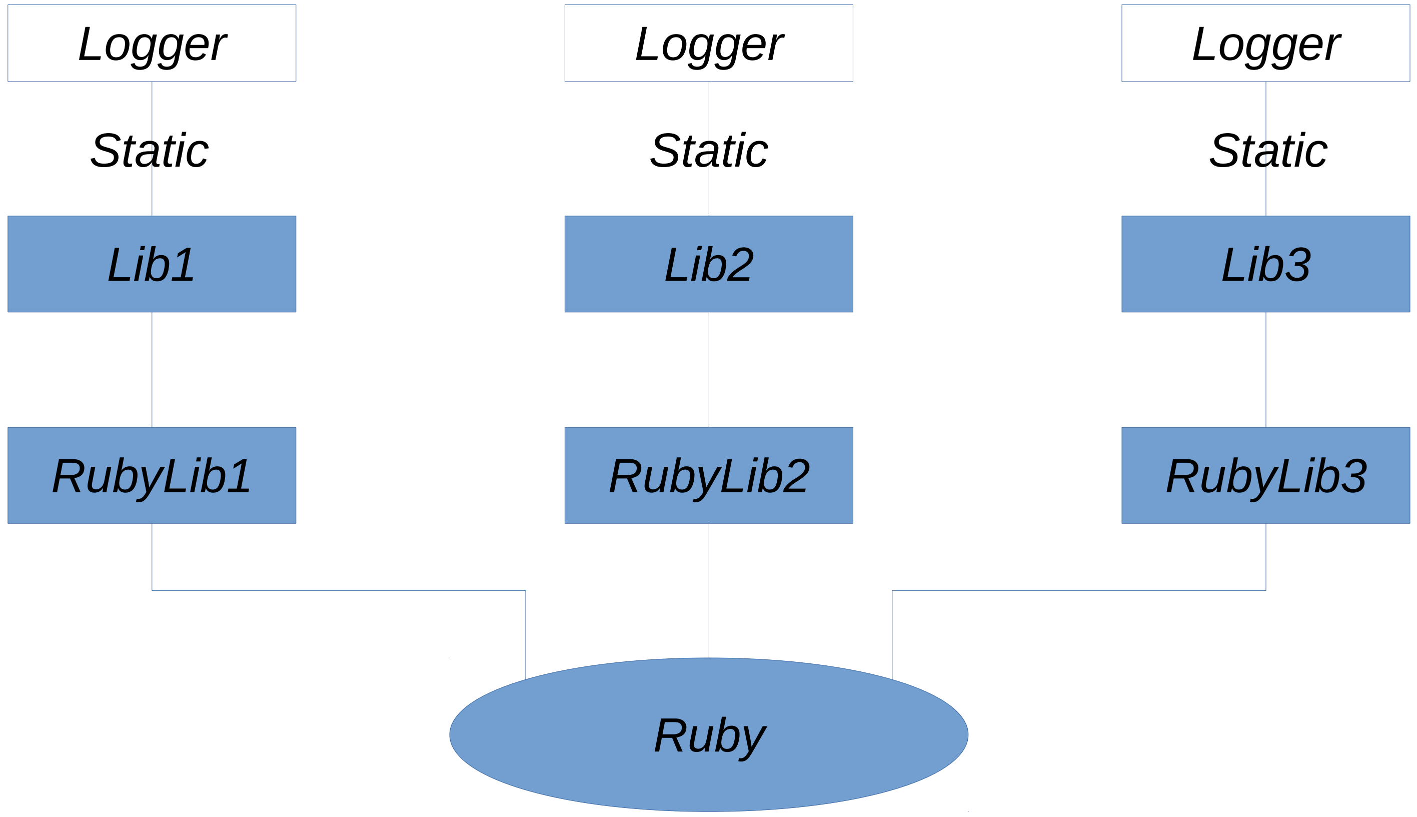
What If The Team Isn't Convinced?

- Make full use of the tools you do have available
- Turn up warnings on current compiler (/W4, -Wall, -Wextra, -Weverything)
- Enable static analysis with MSVC / Clang
- Install Cppcheck
- Enable automated builds
- http://cppbestpractices.com

What are the downsides?

- You must pick a subset of the language that you’ll use
- You must pick a subset of OS/GUI Functionality
- Unexpected differences

Unexpected Differences: Linking



Unexpected Differences: Linking

- Global static logger object linked to 3 different dynamic libraries
- Linux: 1 Logger
- Windows: 3 Loggers
- MacOS: 1 Logger – Freed 3 times (crash on shutdown)

Unexpected Differences: Linking

- Link a static library into your project at most 1 time.
- Prefer either 100% dynamic or 100% static linking
- Dynamically loading with a scripting engine might force you into 100% dynamic
- Avoid singletons as much as possible.

Sometimes you end up with this:

```
#ifdef CHAISCRIPT_MSVC_12
#pragma warning(push)
#pragma warning(disable : 6011)
#endif
          // this analysis warning is invalid in
          //MSVC12 and doesn't exist in MSVC14
          std::vector<Type_Info> retval{types[0]};
#ifdef CHAISCRIPT_MSVC_12
#pragma warning(pop)
#endif
```

Questions?

Jason Turner

- http://chaiscript.com
- http://cppbestpractices.com
- http://github.com/lefticus
- http://cppcast.com
- @lefticus