National Science Foundation

UC San Diego
JACOBS SCHOOL OF ENGINEERING
Structural Engineering

Preparing an NSF Proposal to Utilize NHERI @ UC San Diego

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Joint Researcher Workshop
UC San Diego & RAPID

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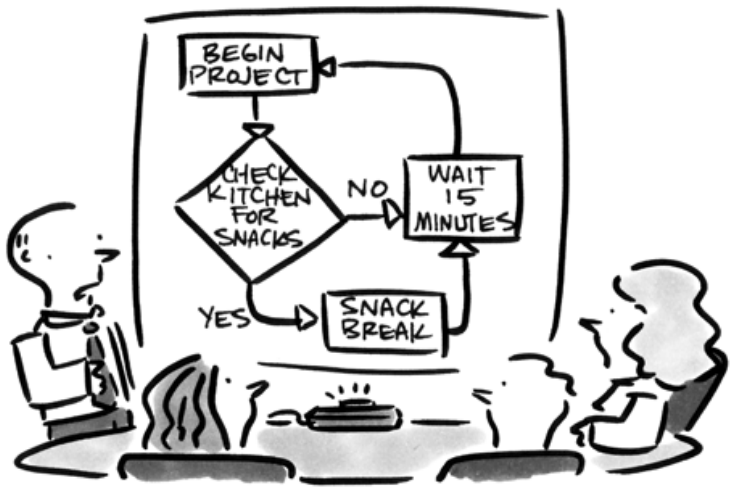
University of California, San Diego

University of California at San Diego
NHERI
Natural Hazards Engineering Research Infrastructure

RAPID NHERI
Natural Hazards Reconnaissance

Key Steps

1) **Define project vision**
   a. Test purpose, impact
   b. Modeling component, impact
   c. Technology transfer
2) **Selecting your team**
3) **Developing your schedule**
4) **Estimating your budget**



"I think I found what's slowing us down..."

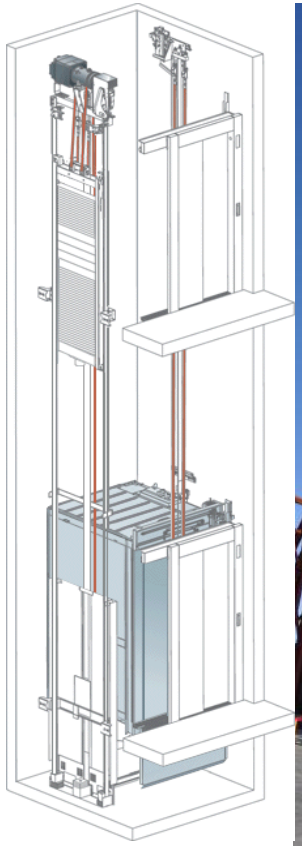
In this discussion, we will focus on test planning in the context of 1-4

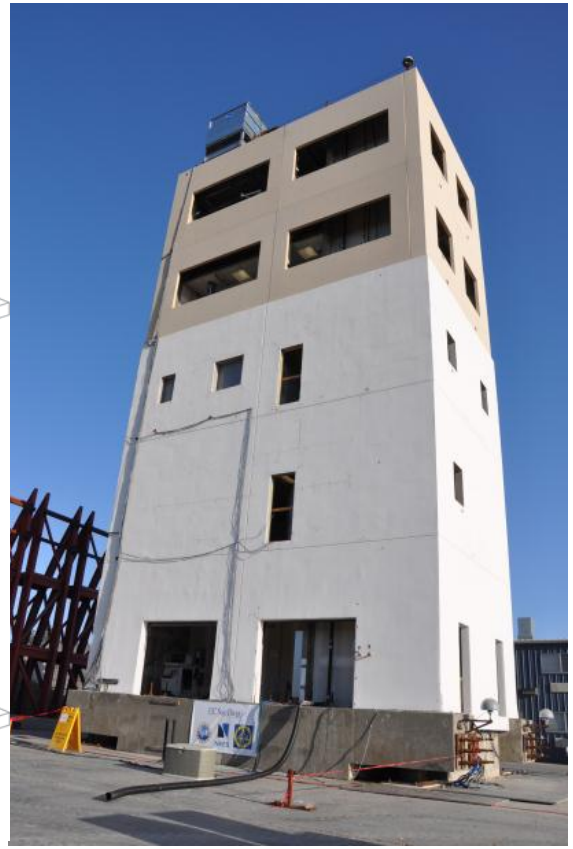
1) Vision, Test Purpose, Impact

- **Outline the Project Vision**
  - These tests are LARGE, COSTLY, and LARGE
  - They will take immense time and resources
  - By their nature, they are landmark and completely unique & support broad *visions to solve grand challenge research problems*
- **Clearly define the Tests Program Purpose**
  - Identify the purpose of the test program
  - Focus on clarifying the mechanisms that will dominate the response; this will help you sell your vision, and know what to measure
  - What are the key gaps in knowledge?
    - ✓ Past related research
    - ✓ Limitations in design codes/methods/standards of practice
- **Incorporate modeling/simulation/design standards, for:**
  - Validation of existing, advancement of new, extending test scenario conditions, etc.

Test Program Overview (NEESR-BNCS)

- **Three-phased full-scale test program conducted on a 5-story building-NCS system**
- **Vision (short): understand total building system seismic response**





Summary of Major NCSs:

- Egress systems:
  - Operable Elevator
  - Stairs
- Facades:
  - Concrete cladding
  - Balloon framing
- Hospital equipment
- Roof mounted equipment
- Sprinkler and riser systems
- Ceilings
- Interior partition walls

HVAC

Facades

Hospital Floor

Project Vision (verbose)

- **To make breakthrough advances in the understanding of total building systems performance (structural *and* nonstructural systems) under moderate and extreme seismic conditions through full-scale testing.**
- **Obtain data, which are sorely needed to characterize the earthquake performance of structural and nonstructural building systems, including nonstructural systems with protective measures.**
- **Use this data to validate nonlinear simulation tools, which in turn can be used for higher-performance code design and performance-based seismic design of nonstructural and building systems.**
- **Infuse findings into seismic design guidelines and codes**
  - Validate current code assumptions
  - Advance current code guidelines

Identify your hopeful impact!

- **State your impact in the context of NSF Merit Review Criteria**
  - Identify the **intellectual impacts**: "..potential to advance knowledge…"
  - Identify the **broader impacts**: "…potential to benefit society and contribute to the achievement of specific desired societal outcomes"

  - **Tip:** review NSF criteria (NSB, 2011) & write your intellectual & broader impacts verbosely within the body of your proposal

2) Choose your project team

- **Complex, large test programs can require input and support from large teams:**
  - Academics (PIs, graduate students, undergraduate students)
  - Industry partners (design engineers, manufacturers, code experts)
  - Staff (your home University, NHERI@UCSD, DesignSafe-CI)

15 members of the “CFS-Midrise Building” test program (2016), three PIs (UCSD, WPI), two grad students, eight industry partners (four companies), two staff

Plan for your Project Leaders

- **Researcher(s) on-site @ UCSD = project leaders**
- **Manage project resources to achieve deliverable (timeline)**
  - Supplies, contractors, equipment
  - Work closely with NHERI staff

- **Before coming to UCSD**
  - Scheduling
  - CAD drawings (construction, instrumentation)
  - Pre-test analysis
    - ✓ Motion selection
    - ✓ Instrumentation layout
  - Prepare mathcad/matlab sheets

- **At UCSD**
  - Instrumentation, cameras
  - Tooling, labeling, oversight/participate in construction

Industry Partners (BNCS)

Also on your team: on-site technical staff@UCSD

Darren McKay
Development Engineer
Shake table operation, instrumentation/planning

Alex Sherman
Site Foreman, Development Technician
Construction/de-erection, instrumentation

Robert Beckley
IT Manager and Network Administrator
Cameras, data storage

Jeremy Fitcher
Development Technician
Construction/de-erection, instrumentation

Acting Site Operations Manager

Roxy & friends
(construction supervisor)

3) Develop your schedule (major items)

- **@Proposal level**
  - *Test planning*
    - ✓ Construction drawings, pre-test modeling, instrumentation planning, material & construction procurement
  - *On-site test efforts*
    - ✓ Construction: duration varies significantly based on test scope (BNCS > 1yr, CFS ~ 5 weeks)
    - ✓ Instrumentation: can vary, 2-4 weeks is common, some can occur during construction
    - ✓ Test Execution: can vary, 2-4 weeks is common, but depends on how many motions, how much in between (different phases/model configurations, retrofit/repair, inspection down-time, etc)
    - ✓ Demolition: don't forget this in your schedule & budget! Can take 2-4 weeks depending on the complexity of specimen!
  - *Post-test data processing*
  - *Post-test modeling*
  - *Technology transfer – outcomes of your research project*

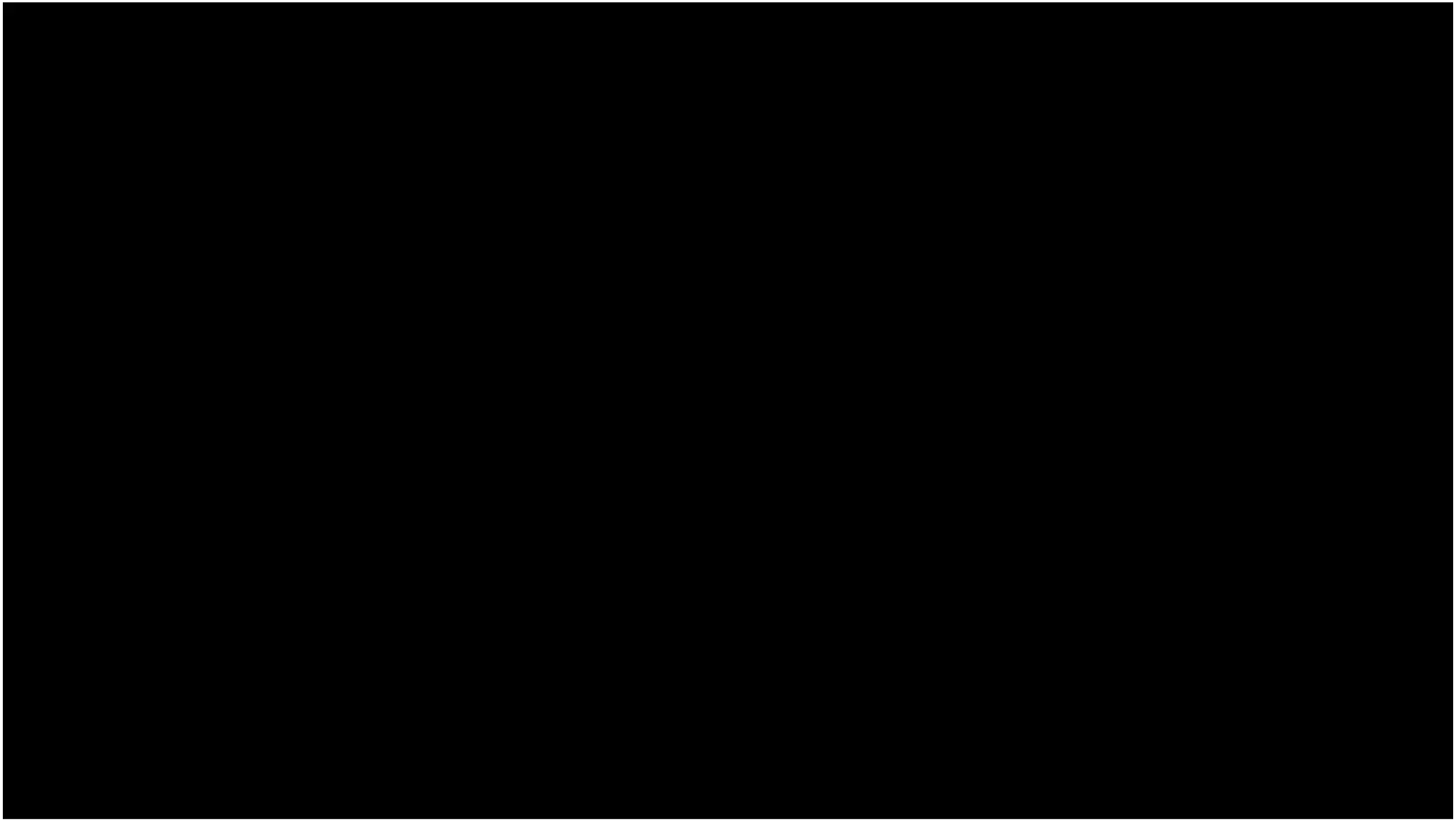
3) Develop your schedule (on-site efforts)

- **@Start of project**
  - Notification of award, rough planning (approximate YrQrt)
  - Prior year (narrow in on the quarter)
  - ~3 months before *(when is highly dependent on complexity)*
    - ✓ Specimen drawings
    - ✓ Test protocol
    - ✓ Motion selection, iteration (bare table)
    - ✓ Instrumentation plans
  - Present to NHERI staff *(when is highly dependent on complexity)*
    - ✓ Solicit input on planning
      - – Specimen preparation phases: Specimen construction, attachment to table, mass assembly/attachment, instrumentation
      - – Test execution phases: motion selection, scaling, ordering, inspection (& repair or specimen modification?) protocol
      - – Test completion: planning for de-erection and disposal of specimen
    - ✓ Assure safety protocols are in place

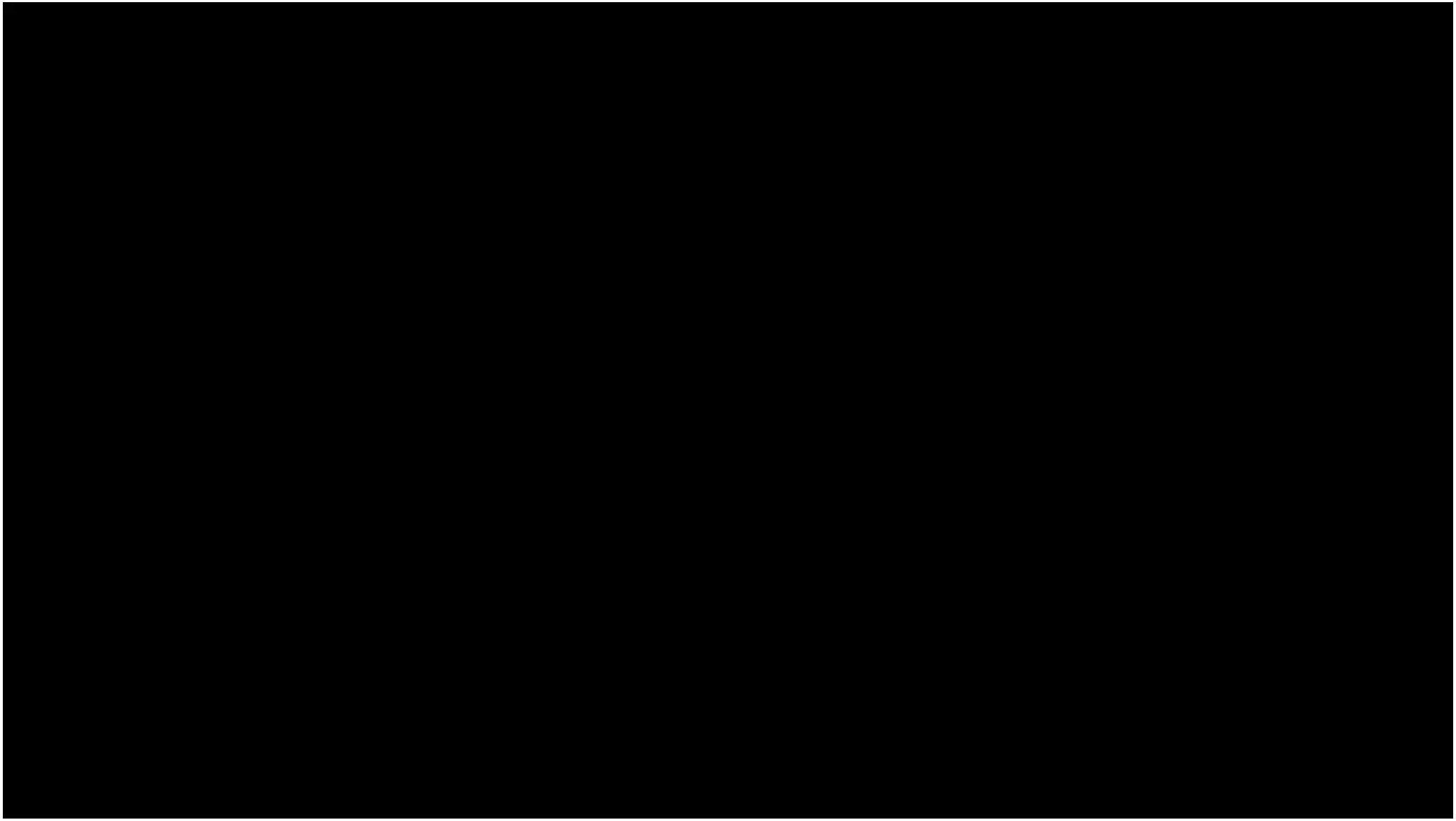
Schedule e.g. (on-site efforts, CFS)

- **Start of construction: (layout, tie-downs); major construction items [4-5weeks]:**
  - Structural framing erector (4/18-4/28); mass installation with floors
  - Doors (framing, finish) (5/8-5/13)
  - Interior work (sheetrock, mud/tape) (5/2-5/13)
- **Instrumentation (5/9-5/27) [3weeks]**
- **Seismic tests (5/30-6/3) [1week]**
- **Remove seismic sensors (6/6-6/10) [1week]**
- **Fire tests (6/13-7/1) [2weeks]**
- **12 weeks total on-site (construction, testing)**
- **1 week rapid, modular de-erection**

Construction Duration Varies Greatly!



Deconstruction Duration Varies Greatly!



Schedule e.g. (on-site efforts, superstructure construction, BNCS)

ROOF SLAB:
September 21st,2011

FIFTH FLOOR SLAB:
September 6th,2011

FOURTH FLOOR SLAB:
August 19th,2011

THIRD FLOOR SLAB:
August 3rd,2011

SECOND FLOOR SLAB:
July 15th,2011

FOUNDATION:
June 27th,2011

Research Activities (during construction)

- **During construction, research team needed to multi-task**
  - Conduct pre-test simulations (guide motion selection, instrumentation layout)
  - Watch, document, & take part in (as feasible) construction
  - Create instrumentation drawings
  - Watch, document, & take part in (as feasible) construction
    - ✓ We created a weekly construction log documenting all key construction activities digitally & disseminating them during a weekly team meeting

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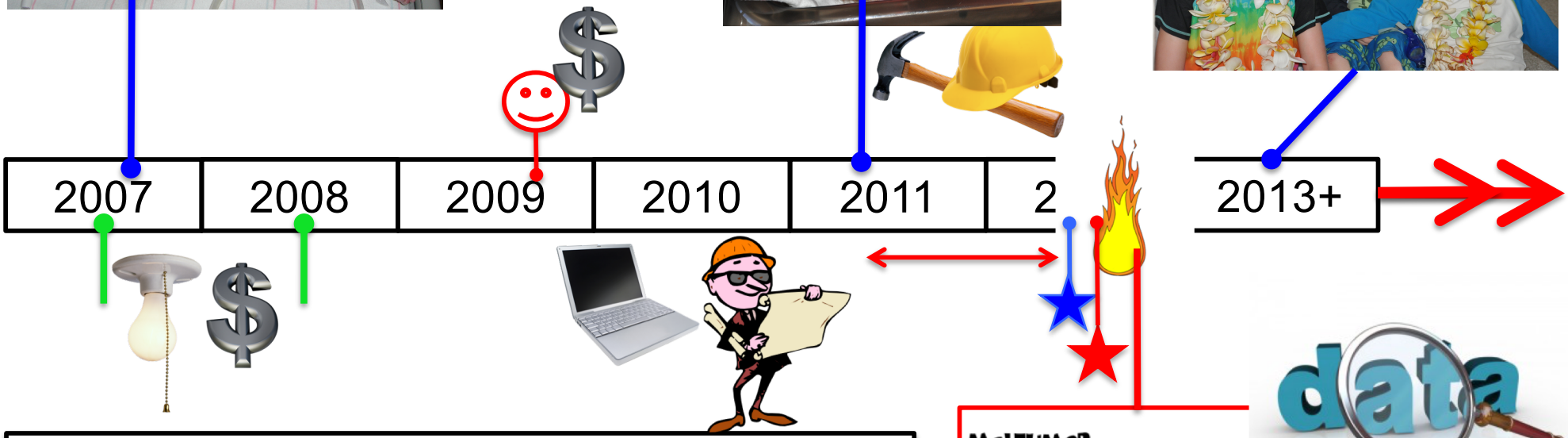
Temus: March 31, 2011



- Pre-proposal workshop
- NEESR Funding & Kick-off meeting
- Construction (~9m)
- Seismic Testing Phases (~1m)
- Live Fire Testing (~0.5m)

4) Estimating your budget *(Big Picture)*

- **Research staff (PI, students)**
  - Carrying out tests, modeling, project, etc.
  - How many and for how long (designate PI/students to major items)
- **Tests**
  - Physical test costs
  - Can vary dramatically, some ideas next slide….
- **Travel, workshops**
  - Supporting your research planning and dissemination
  - How much, how many, purpose, etc.

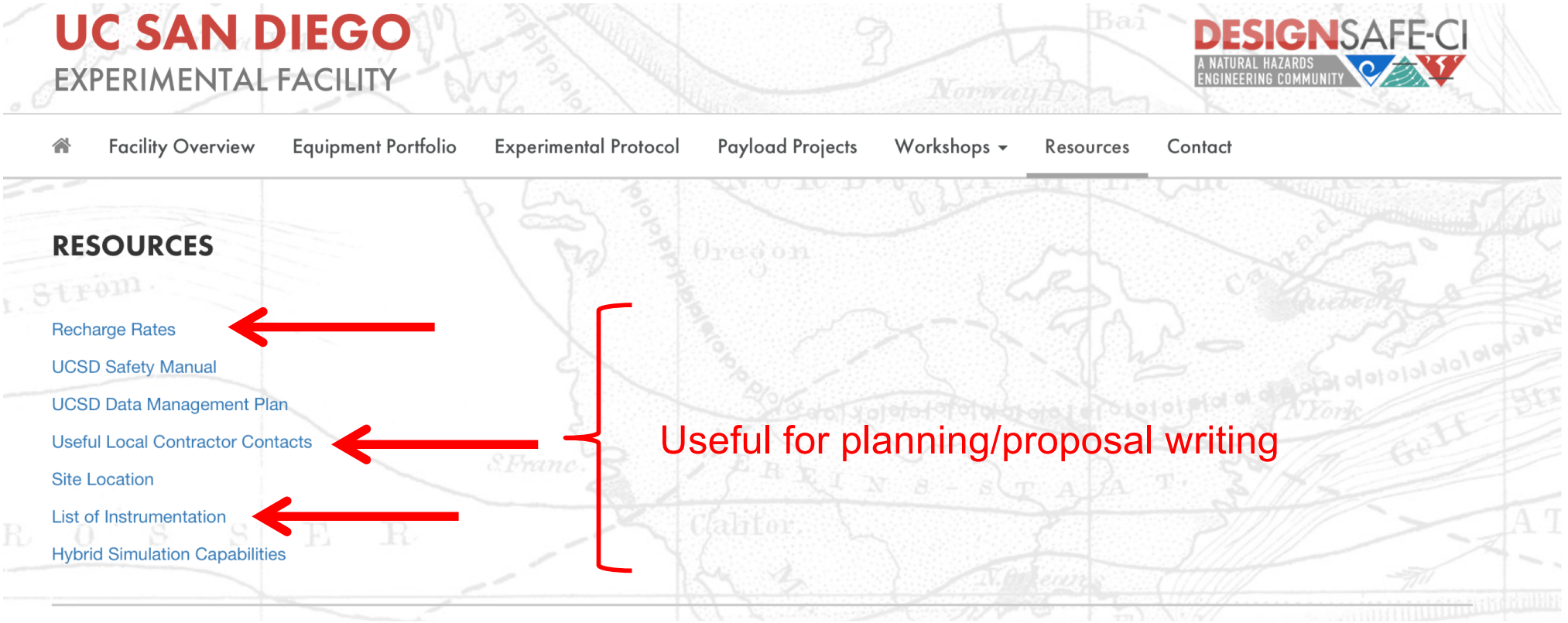
Overall budget heavily linked to duration, scope of tests, and additional support (outside of NSF resources)

4) Estimating your budget *(Physical Test Costs)*

- **Site will support operations during construction and de-erection**
  - Guidance regarding test planning
  - Over-sight of construction and de-erection; execution of tests
- **Site is not able to support construction and de-erection costs – you will need a separate budget for these costs**
  - Select several contractors, request estimates; understand their heavy equipment needs (during construction they will need to either rent the sites equipment or obtain rental outside of site)
  - For initial planning/budgeting, select UCSD-vendor contractors
- **Site will provide and support placement of all major sensors**
  - Analog sensors, camera system – check our inventory against your needs, if there are specialty sensors you will need to budget for them
- **Site will not support cost of expendables associated with sensors – you will need a separate budget for these costs**
  - Strain gages, cabling, labels, unique support brackets for sensors or cameras, damaged sensors and cables (include SOME allowance)

Additional Resources (via DesignSafe)

- https://ucsd.designsafe-ci.org/resources/



4) Budget: Expect the Unexpected!

Testing Scope & Project Resources (BNCS)

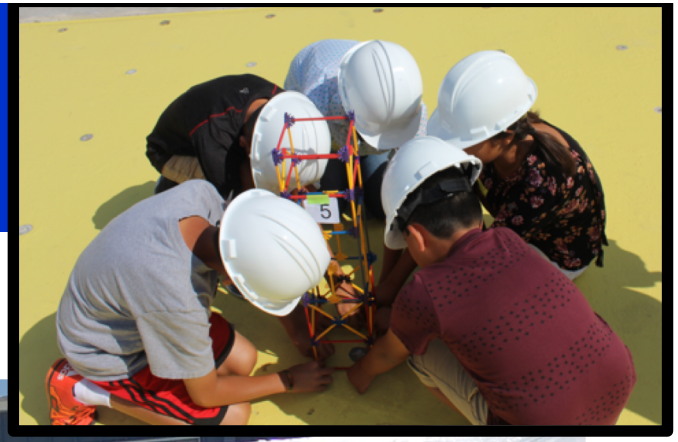
- **Three Test Phases**
  1. Base isolated building-nonstructural system
  2. Fixed base building-nonstructural system
  3. Controlled live fire tests
- **~5M US$, multi-organizational 4 year project (2010-2014)**
  - NSF-NEES core research project - $1.2M
  - Englekirk Advisory Board - $1.5M (est)
  - Charles Pankow Foundation - $250k
  - California Seismic Safety Commission (hospitals) - $360k
  - Industry consortium - remainder $ resources, materials, equipment, technical expertise, etc.

Other considerations when planning your NSF research program: *ECO*

- **Education & community outreach (ECO) is a key element in NSF merit review (broader impacts)**
- **Experience of NHERI@UCSD Team:**
  - Technology transfer (webinars, project videos, laboratory tours, etc)
  - Media relations [Jacobs School of Engineering Media Team (available to help)]: https://jacobsschool.ucsd.edu/news/media-contacts
  - Educating future engineers
    - ✓ Seismic outreach ambassador program (eg. NHERI4kids)
    - ✓ NSF NHERI REU
    - ✓ Graduate student training

Please contact Prof Lelli van den Einde @UCSD for these and many more ideas

NHERI4kids



- Testing their kNex structures on table

Last Remarks

- **NHERI@UC San Diego staff and PI/Co-PIs/SP are available resources to help with your proposal planning and project execution**
- **We recommend discussions during proposal preparation to help develop scope & budget**
- **All conversations are kept confidential**
  - We want to help you succeed!
  - The actual level of early interactions during project planning with NHERI@UC San Diego is up to you - but again, we want you to succeed!

Please reach out – we are here to help you prepare/plan the advancement of your your unique ideas using NHERI@UC San Diego