Traditional Project Delivery

- Design- Bid- Build
- Silo- based
- Inefficient
- Costly
- Litigious
- Does not encourage innovation
- Limited “value added” to project owner
What is IPD?

- Integrated and team-based approach to project delivery
- Early involvement of key team members
- Early resolution of issues
- More communication, sooner
What is IPD?

Project Progress

Design Effort/Effect

1. Ability to impact cost and functional capabilities
2. Cost of design changes
3. Traditional design process
4. IPD design process

Graphic originated by Patrick MacLeamy, FAIA
What is IPD?

- Collaborative process
- Alignment of goals
- Collectively developed, validated, and tracked performance targets
- Collective Project Control
- Shared risk/reward based on the project outcome
IPD Requires:

- Broad understanding of design and construction issues by all members
- Knowledge of the challenges of all players
- Commitment to Team success
- Enhanced communication
- Easy and timely access to information by using shared models
UCSF Regeneration Medicine Building – A Case Study
# Project Team

<table>
<thead>
<tr>
<th>Role</th>
<th>Firm Name</th>
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<td>Owner’s Rep.</td>
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Project Funding

- Project Cost: $119M
- Construction: $76M
- CIRM Funds: $35M
- Balance: UCSF + Private Donations
Delivery Method

- Bridging Design
  - RVA/NYA

- Design/Build Competition
  - Funded Competition
  - Best Value Selection

- Results
  - Reduced Construction Cost
    - $20 million
  - Reduced Overall Project Schedule 2 years
### Design Process

**DESIGN SCHEDULE**

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* May 6, 2008

- June 6, 2008
- June 18, 2008
- July 9, 2008
IPD Characteristics

- Collaborative Relationship Between Owner and D-B Team
- Major Consultants and Sub-Contractor’s On-Board Early
- Engagement with Bridging Team (RVA / NYA)
- Collectively Manage Owner’s Contingency
- Incentive Program
- Effective Use of BIM
IPD Advantages

- Integrated Design Process
- Constructability Input
- Cost /Benefit Analysis
- Quick Resolution of Unforeseen Conditions
IPD Disadvantages

- Design Management
- Multiple Scheme Review
- Scope Creep
Elevations
Bridge Structure

REVIT Model
Structural Design Criteria

- Seismic Design Intent
  - DBE (475-YR): Fully Operational
  - MCE (970-YR): Operational
  - Structural Peer Review
Earthquake Performance Levels

<table>
<thead>
<tr>
<th>Earthquake Design Level</th>
<th>Fully Operational</th>
<th>Operational</th>
<th>Life Safe</th>
<th>Near Collapse</th>
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<tbody>
<tr>
<td>Frequent (43 year)</td>
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<td>Occasional (72 year)</td>
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<td>Unacceptable Performance (for New Construction)</td>
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<td>Rare (475 year)</td>
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<td>Essential/Hazardous Objective</td>
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<tr>
<td>Very Rare (970 year)</td>
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<td>Safety Critical Objective</td>
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Code Design Basis for Conventional Structural Systems

![Graph showing earthquake force demand over building period]

- **Design Basis Earthquake**
- **Equivalent Code Design Basis**

**Axes:**
- Y-axis: Earthquake Force Demand (% g)
- X-axis: Building Period (sec.)

Key points:
- ? mark indicating a question or topic of interest.

Forell / Elsesser Engineers
Base Isolation Advantage

- Fixed Base Buildings
- Lateral Load Factor
- Building Period
- Isolated Buildings
- Isolation Response
Seismic Isolation Benefit

Altered Seismic Behavior

Large Interstory Drift

Small Interstory Drift
Friction Pendulum Isolator

Final Condition

Isolator Cross Section

Prototype Test
Design Considerations

- Site Conditions
- Complex Geometry
- Exposed Structure
Site Conditions

- Steep Hill
- Slide Zone
- Existing Pump House
Geometry

- Geometry
  - Radial Grids
  - Varying Grades
  - Column Tree Design
Geometry

TEKLA Model
Exposure Requirements

- Exposed structure considerations
  - Aesthetics
  - Corrosive Environment
Seismic Isolation Challenges

- Drilled Pier Properties
- Seismic Overturning
- Isolator Uplift
Drilled Piers

- Variable Heights
- Variable Diameters
Seismic Overturning

- Overturning
  - Narrow Structure
  - Minimal Dead Load on Uphill Side
  - No Tension Capacity in Isolators

Diagram illustrating applied and resisting forces with annotations for C1, C, B, and A points.
• 42 Friction Pendulum Isolators
• 8 Dynamic Uplift Restraints
Typical Isolator Uplift
RMB without Uplift Restraint

Vertical Displacement (in) vs Time (sec)

- RMB without Uplift Restraint
- Typical Uplift
Uplift Restraint Design

Mockup

Concepts
Uplift Restraint Travel

**SECTION**

**ELEVATION**

**PLAN VIEW**

- Stainless steel concave surface
- Concave plate
- Seal
- Assembly slider

---

**Graph**

- Vertical Displacement (in) vs. Horizontal Displacement (in)
- Triple Pendulum Isolator Travel
- Dynamic Tension Restraint Travel
Uplift Restraint Design

Working Drawings

Prototype

03/04/2009
Uplift Restraint Simulation
Sub-Assemblage Simulation
Uplift Restraint Test
Uplift Restraint Installation
Questions?